BUILD A KICK-ARSE BUDGET GAMING PC

PC

Sept 2017
Issue 445

EXPERT GUIDE TO TODAY'S TECH

INTEL STRIKES BACK!

WE ROUND UP THE BEST X299 MOTHERBOARDS AND X-SERIES CPUs! ARE THEY GOOD ENOUGH TO TAKE DOWN AMD'S RYZEN?

GET YOUR DIGITAL STORAGE IN ORDER WITH OUR 2017 SUPERGUIDE!

- 4-BAY NAS BOXES
- HIGH-CAPACITY USB DRIVES
- HOW TO BACK UP WINDOWS PROPERLY

STORE MORE STUFF!

TREMENDOUS TECH HOW-TOS

→ TURN A PI INTO A POWERFUL OPEN-SOURCE ROUTER
→ MASTER ADVANCED VOLUME CONTROL IN WINDOWS
→ SET UP EXTRA PROTECTION FOR YOUR APPLE ID
→ RUN ANDROID 7.0 ON YOUR PC

HUGE GUIDE: HOW TO SWITCH TO LINUX

→ EVERYTHING YOU NEED TO KNOW TO DITCH YOUR PC OR MAC AND JUMP TO THE OPEN-SOURCE ALTERNATIVE

FIRST NVIDIA MAX-Q GAMING LAPTOP REVIEW

→ FULL REVIEW OF ASUS's ASTONISHINGLY-THIN AND SPEEDY ROG ZEPHYRUS!

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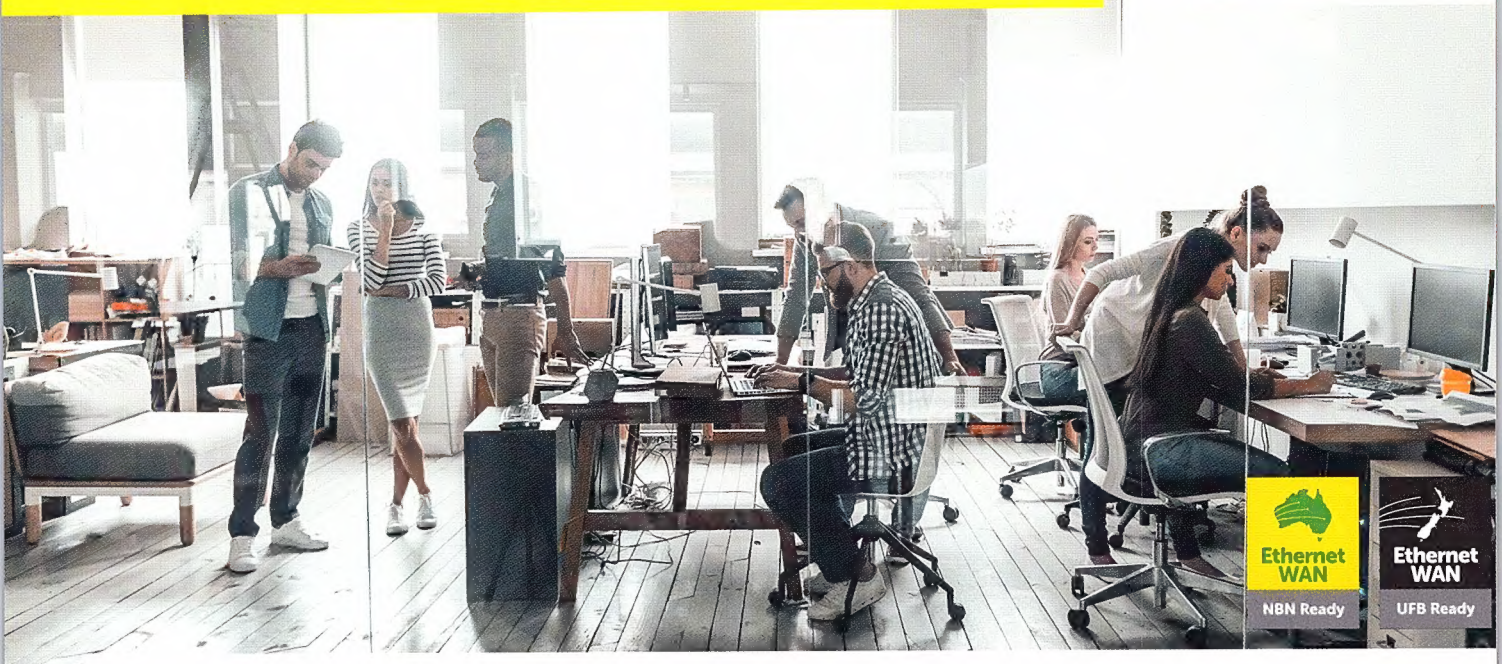

TAIWAN EXCELLENCE 2013

50x VPN

Vigor2925 Series

Dual-WAN Gigabit broadband router with Security Firewall, 50 x VPN tunnels, and 25 x SSL-VPN tunnels

- Dual Gigabit WAN ports with 3G/4G Load Balance and failover
- 5 x Gigabit Ethernet LAN ports with 50,000 NAT sessions
- 50 x VPN tunnels with Central VPN Management & 25 x SSL-VPN tunnels
- 4G LTE SIM card slot (L model)
- Object-based Firewall
- IPv6 & IPv4
- 2 x USB ports for 3G/4G LTE mobile broadband access, USB printer, storage and thermometer
- 802.11ac (ac model)
- 802.11n (n model)
- VoIP (V model)
- Central AP Management (up to 20 Access Points)
- Central Switch Management (up to 10 Switches)
- Smart Monitor Traffic Analyzer (up to 50 nodes)

Vigor2912 Series

Dual-WAN broadband router with Security Firewall and 16 x VPN tunnels including 8 x SSL-VPN tunnels

TAIWAN EXCELLENCE 2014

16x VPN

- 1 x Fast Ethernet WAN port
- 1 x Selectable WAN/LAN port
- Load balancing & Failover
- 3 x Fast Ethernet LAN ports
- 30,000 NAT sessions
- Object-based SPI Firewall
- Content Security Management (CSM)
- 16 x VPN tunnels
- IPv6 & IPv4
- 1 x USB port for 3G/4G LTE mobile broadband access, USB printer and storage
- Multi subnet WAN/LAN through 802.1Q
- Comprehensive QoS features
- Works with VigorACS SI management system
- Smart Monitor Traffic Analyzer (up to 30 nodes)
- 802.11n Wi-Fi (n model)

Vigor2120 Series

Gigabit broadband router with Security Firewall and 2 x VPN tunnels including 2 x SSL-VPN tunnels

2x VPN

- 1 x Gigabit Ethernet WAN port
- 4 x Gigabit Etherent LAN ports
- 1 x USB port for 3G/4G LTE mobile broadband access, USB printer and storage
- 2 x VPN tunnels including 2 x SSL-VPN tunnels
- Comprehensive QoS features
- Object-based SPI Firewall
- Content Security Management (CSM)
- Multi subnet WAN/LAN through 802.1Q
- IPv6 & IPv4
- 2.4/5 GHz Concurrent Dual-Band Wi-Fi (n-plus model)
- Works with VigorACS SI management system

i-LAN TECHNOLOGY

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FIPP

Privacy and trust in the smarthome

APC's editor mulls over what the arrival of AI home assistants means for our digital privacy.

Google Home has finally launched in Australia and it could be just what the smarthome revolution has been waiting for. On its own, Home is a pretty neat smart speaker that's able to stream music and do general 'smart AI assistant' things, like answer simple questions by Googling them and reading out the answer, add items to your shopping list and appointments to your calendar, or tell you what today's weather is.

Really, the Home's niftiest feature is arguably its ability to act as a smarthome hub. This is the device the smarthome has needed since the beginning, as it's able to tie together a whole bunch of disparate third-party smarthome devices and systems and let you control them, individually or as groups, just using your voice.

So should you get one? Personally, I am still on the fence. That's because Home brings with it a whole fishtank full of privacy concerns that I don't quite have all the answers to. Some of that is because they relate to big-picture questions about our digitally-driven lives – like how much privacy can we expect, how much we're entitled to... and, perhaps most pertinently, how much we're voluntarily willing to give up.

That issue of privacy largely revolves around who we trust – and for most of us, that's a very personal decision. Can we trust big tech companies with our private lives? The jury is still very much out on that one. While they've made encouraging moves – such as being bullish in the face of government requests to create backdoors in encrypted products – the level to which I trust different companies greatly varies.

I'd rate Apple as the most trustworthy tech giant when it comes to privacy, simply because all its products are paid-for and it makes its money directly from the consumer. (That doesn't, however, mean I agree with all its business practices...) Google's overarching business model, on the other hand, is very much one where *you* are the product – if you're using its free services, it's collecting data about you that's geared towards selling ads. I'm mostly OK with that, and Google does actually offer account tools that let you turn this off, if you wish. That general transparency means I'm willing to give the company a fair amount of my trust – although (like many *APC* readers, I'm sure) I'm not certain whether that trust should extend as far as having an always-on, Google-powered listening device sitting in my living area... What do you think? ■

DAN GARDINER
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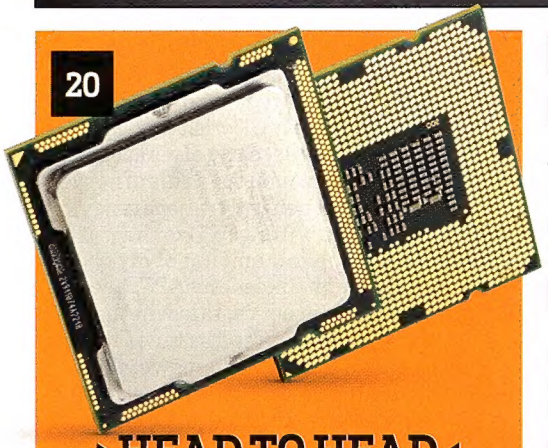

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› HEAD TO HEAD ‹
x86 vs ARM

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» HOW TO DOWNLOAD YOUR FREE FULL-VERSION PROGRAMS

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Please note that these exclusive *APC* & *TechLife* magazine downloads will only be available for a limited time, from **17/08/2017** to **04/10/2017.**

EXCLUSIVE GIFT 01

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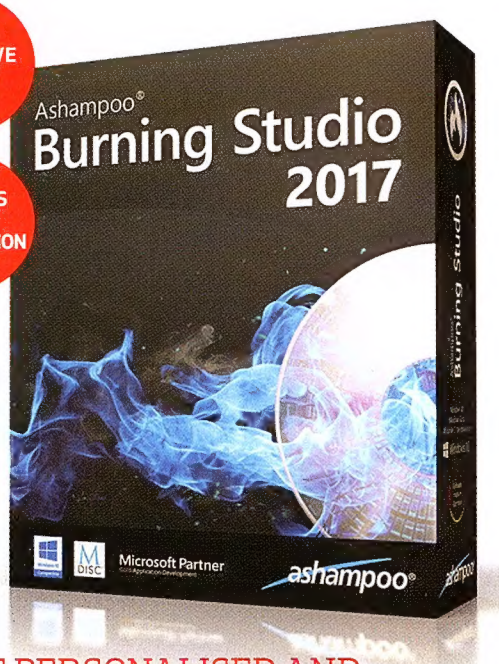

CREATE PERSONALISED AND PROFESSIONAL DISCS WITH EASE

Make CDs and DVDs like a pro with Ashampoo Burning Studio 2017

FULL VERSION REQUIRES ONLINE REGISTRATION.

Ashampoo Burning Studio 2017 is a powerful burning application that covers various use cases. It burns files, music or movies and extracts audio from CDs but also provides backup functionality for external devices such as flash drives, mobiles or tablets. The integrated cover editor helps with designing individual covers and booklets and comes with multiple ready-to-use templates for quick results. Copying existing discs is effortless, this includes the creation, browsing and burning of disc images.

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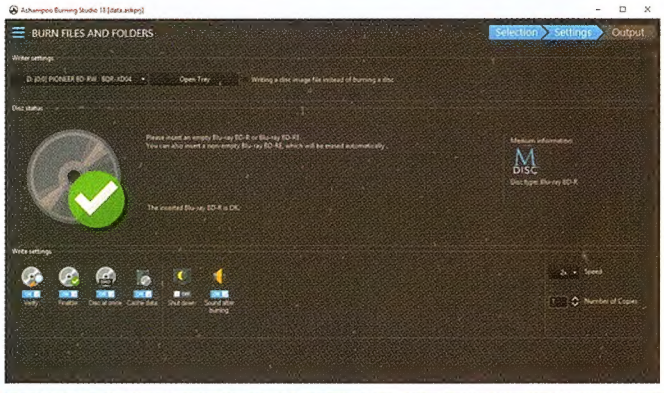

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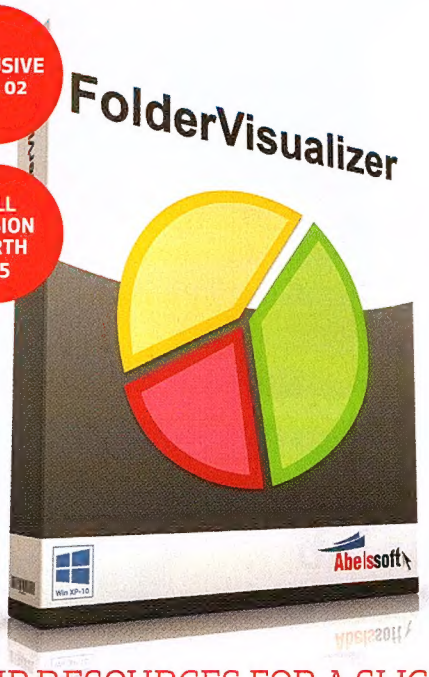

FREE UP RESOURCES FOR A SLICKER EXPERIENCE

Manage memory consumption with Abelssoft FolderVisualizer 7

FULL VERSION WORTH $45

Even the largest hard disk fills up: Countless videos, archives, photos and backups take a huge amount of existing space. The Windows Freeware FolderVisualizer 7 assists and scans internal and external hard drives in order to search for files that are demanding space on disks. The new version offers a five-times-faster examination and helps the user with detailed file information in order to make the right decision.

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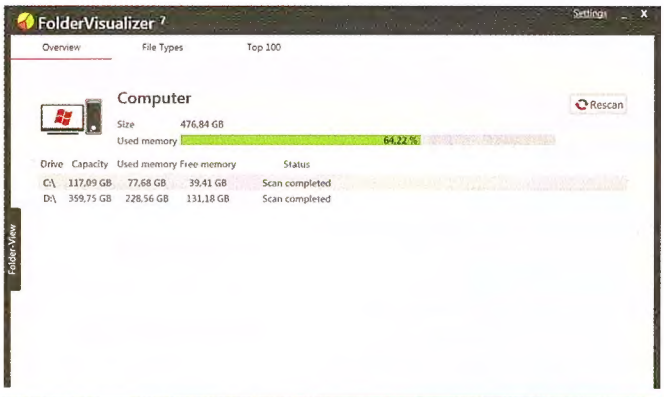

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the lab
» LATEST REVIEWS
apc HOT PRODUCT
SMART SPEAKER
$199 | MADEBY.GOOGLE.COM
Google Home
We adopted Google's new voice-controlled smart speaker to see if it can really pull its weight around the house.
Imagine this: You have a new roommate that turns the heater for you when you get home, warms up the coffee machine before you wake up in the morning, reads you to sleep at night and makes sure to turn off the bedside light when you're drifting off. This roommate shows patience when you yell, does their best to dig out answers to the obscure information you ask for, knows your personal taste in music and will play new songs that you might like. And while your roommate isn't always the sharpest, you know it's there to listen. And it'll even call you 'Supreme Leader', if you want. That roommate is the Google Assistant, and it lives in the palm-sized pod that is the Google Home.
THE LAY OF YOUR SPEAKER
Google Home wears a few hats, but its primary function is to act as a voice-controlled, internet-connected speaker. The Google Assistant can be called upon to play specific tracks from connected music streaming services like Google Play, Spotify or the radio-streaming service TuneIn, but if you don't have a subscription to any of these services, the Google Home comes bundled with six months free access YouTube Red, allowing you to cast music. If you happen to have a Chromecast Audio attached to an old receiver or your favourite speakers, you can also get Google Home to cast music directly to your living room. Sadly, at the moment you can't cast the same song across Google Home and a Chromecast Audio yet.
Of course, those audio streaming services aren't going to satisfy everyone. At present, you can't control any other services using your voice, but Google Home has all the tech needed to act as a Chromecast receiver, so it's just a matter of going into the third party app and clicking the 'Cast to Google Home' button. That does bring popular apps like Pocket Casts, TED, Plex, SoundCloud, CloudPlayer and Chrome into the fold.
THE STAMP OF A GOOGLE
Google Home is a smart little wireless speaker, so when you factor in that it costs $200 – notably less than many similarly-sized portable Bluetooth speakers – it makes you wonder how audio actually sounds. But this bowling pin shaped boom-box has one major advantage over it's portable compatriots... it's connected to power. The fact that the Google Home's single 2-inch driver doesn't need to be optimised to use as little battery power as possible means it's got a competitive edge – and they do punch well above their weight. It's no match for a dedicated hi-fi system, but for basic music and podcasts that you'll listen to in the background, it's perfect. Dual 2-inch passive radiators add more than enough punch at the low end, while the full-range driver adds warmth through the mid-tones and precision at the top end, and a reasonably-loud maximum volume with minimal distortion.
IS THERE THE INTERNET OF THINGS IN THERE?
The audio element of Google Home arguably makes it worth the asking price on it's own, but playing tunes is really less than half of what the unit can achieve. This little penguin-shaped butler is also the best central smarthome hub we've yet come across. At launch, Google had already done a lot of legwork to make sure the Home can talk to any smarthome gear you might have. The search giant has added compatibility with Belkin's WeMo, TP-Link's Kasa, D-Link's Home, Alphabet's Nest, Phillip's Hue and Telstra's Smarthome products to
For $59, you can swap out the black grey speaker grill for a Carbon or Copper base that'll add some drama to this subtle piece of tech.
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Inside APC

Find out all about *APC*'s editorial policies, test practices, how to read the benchmark results and more.

APC is Australia's oldest consumer technology magazine – having been consistently in print for over 35 years, since our first issue way back in May 1980 – and we take that heritage and responsibility very seriously. While our focus is obviously on the personal computer – it's in our name, after all – the very definition of the PC has changed and shifted markedly since the early 1980s. As such, we touch on many other areas of tech too, from smartphones and apps to peripherals, accessories, online services and beyond. We have two main goals: to track down the best of modern tech and also to help our readers make the most of it.

We're also an open church in terms of platforms. We know most people aren't wed to a single brand's products and use a variety of devices. And like you, *APC*'s journalists want to know what's good in tech – no matter what platform it resides on.

INDEPENDENT REVIEWS

Championing technology doesn't mean we're unrelenting yes-men, however, and *APC* aims to be as objective as possible in all our coverage. That means identifying the best products from multiple perspectives – the best performance, best value and best features and, ideally, the products that offer the best mix of these three.

As a matter of policy, reviews published in *APC* are not shared with product-makers prior to print. We will contact vendors under certain conditions; for example, if we have a problem testing a product that seems to indicate it may be faulty, or to invite a vendor to clarify how a particular feature works. If an *APC* reviewer has any potential conflicts of interest involving a brand, the review will always be assigned to another writer.

LABS TESTING

Despite being a small magazine with limited resources, *APC* still still strives to conduct the most rigorous, objective scientific tests and benchmarks we can so as to make our reviews as unbiased as possible. We use a variety of tools and programs for this, including many freely available benchmark suites for assessing media encoding, general system performance, gaming and battery life.

In most cases, for the benchmark results published in *APC*, you can assume that higher is better. There are certain tests that deviate from this rule and where the opposite is true; in those cases, we've flagged the results with a note explaining as such.

We use both tables and graphs for displaying results; the latter are our preference due to their ease-of-readability, but tables are more compact, so we use these in cases where thoroughness is preferred.

technotes

» NEED TO KNOW

Bupa Global data breach has affected nearly 20,000 Aussies

OVER 500,000 CUSTOMERS' INFORMATION LEAKED.

About 547,000 customer records were leaked online recently by a disgruntled employee at the Bupa Global division in the UK, with 19,595 Australians amongst those affected. The health insurance provider admitted that the employee had "inappropriately copied and removed some customer information", like names, dates of birth and contact information, and had "made it available to other parties". Bupa will be taking legal action against the employee and has been contacting the affected customers to apologise. SS

Suspected of a crime in South Australia? You'll need to give up your passwords

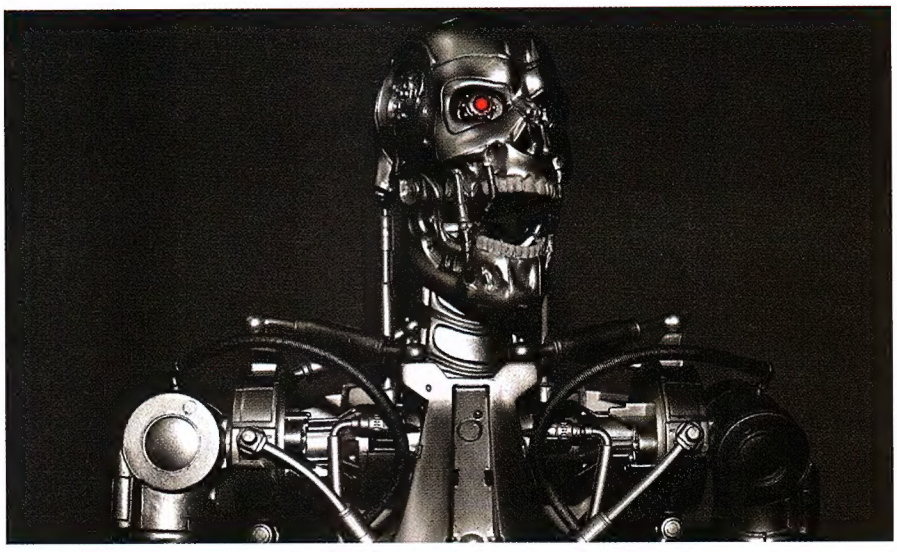
COUGH IT UP, MATE.

South Australia will soon introduce a new law that will see suspects forced to give up computer passwords or face jail time. The law is being drafted in consultation with SA senior police, who have repeatedly complained about thwarted investigations thanks to current legislation protecting privacy. Although the new law is aimed at those involved in access and distribution of child exploitation material, it could also be put to use in controlling organised crime. SS

China and Russia make moves to ban VPNs

TAKING CENSORSHIP TO NEW HEIGHTS.

Russia has passed controversial legislation that bans VPNs and cracks down on anonymous instant messaging services in a bid to prevent the spread of extremist ideology. China, meanwhile, has already started enforcing a similar law, with the country's major telcos having to block VPNs from February 2018. To comply, Apple has already removed VPN apps from the Chinese App Store. SS



Musk and Zuckerberg face off over reality of AI threat

While AI scientists quietly have their say, too.

Tech entrepreneur Elon Musk has made his stance on AI clear in the past – it needs to be regulated... now. He drove this point home recently when speaking at the National Governors Association in the US, calling unregulated AI "a fundamental existential risk for human civilization" and saying that "we need to be proactive in regulation and not reactive [...] by the time we're reactive, it's too late".

Facebook CEO Mark Zuckerberg, who calls himself an 'optimist' about AI, came out against Musk's statements in a Facebook Live presentation, labelling Musk and similar AI naysayers as "irresponsible" for whipping the public up into a doomsday frenzy. Zuckerberg wasn't alone in admonishing Musk's outcry, as several notable AI scientists and researchers claimed that he was "distorting the public debate" before weighing in themselves, often pointing to other threats they deemed more severe – such as "mass population control via message targeting". (We wonder if Zuckerberg is optimistic about that...) Musk isn't alone in his fears, however, with public figures such as Stephen Hawking and Bill Gates also expressing concerns over the unchecked development of AI. **Harry Domanski**

Slow NBN speeds: ACCC puts Aussie telcos "on notice"

DELIVER PROMISED SPEEDS OR FACE LEGAL ACTION, PROVIDERS WARNED.

The Australian Competition and Consumer Commission (ACCC) is preparing legal action against the four major Aussie telcos for selling high-speed NBN packages that have failed to deliver on their speed promises. The ACCC has repeatedly warned the Australian telcos about selling products that promise an 'up to' speed if those speeds can't be achieved, but has so far not taken any specific actions against the telcos. Now, however, ACCC chairman Rod Sims has warned that service providers could find themselves in court by the end of the year if they continue to deliver speeds that are lower than advertised.

When advertising NBN packages, Mr Sims said that the telcos have been asked to use the term 'typical' rather than 'up to' when referring to peak-time speeds. And although all telcos are subject to Australia's consumer laws, Mr Sims said the Commission will target the bigger players, specifically Telstra, Optus, TPG and Vocus. "They have been put on notice and some of them know that they are subject to investigation by us," he said. **Sharmishta Sarkar**

Pakistan's prime minister brought down by a font

CLASSIC CALIBRI, SUCH A TROUBLEMAKER...!

As Pakistani officials were investigating the financial assets of the country's Prime Minister, Nawaz Sharif, they stumbled across some seemingly trivial but potentially damning revelations. Financial documents submitted by Prime Minister Sharif that were dated 2006 used Microsoft's Calibri font, but according to the font's creator, it wasn't publicly available until 2007. It was the tipping point of an already tumultuous prime ministership, and helped oust Sharif, who was being investigated for his use of tax havens. **HD**

Kaspersky banned by US Government amid unsubstantiated spying rumours

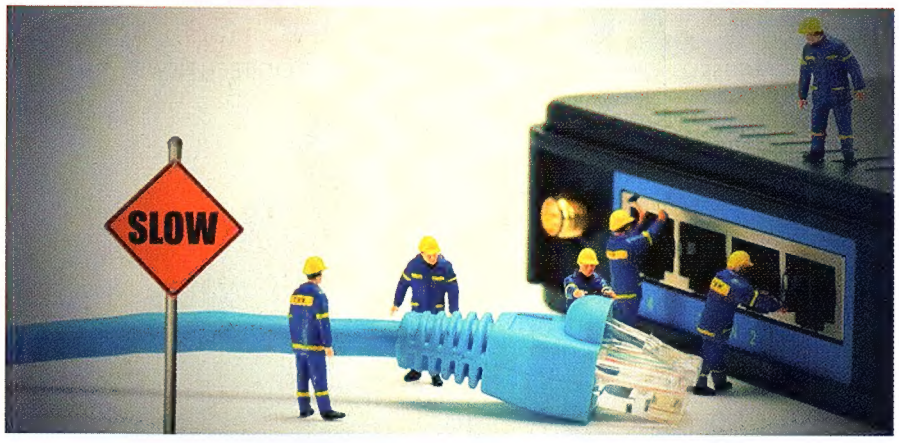
FROM RUSSIA, WITH LOVE?

The US General Services Administration has taken Kaspersky Labs cybersecurity software off its list of approved vendors, essentially making it much trickier for certain government services to install the software, with the intention of discouraging the use of the Russian-based product. This is in direct response to unsubstantiated claims that the company is connected with the Russian Government and uses its software to spy on US citizens. Kaspersky has hit back, stating that "it has no ties to any government". **HD**

NBN rollout reaches 50% mark

BUT THE SIGNUP RATE IS STILL NOWHERE NEAR THAT HIGH.

In early July, NBN Co stated that the National Broadband Network rollout had reached a new milestone, with "5.7 million Australian homes and businesses now able to order a service from their retailer" — meaning that half of the country now has the option to connect. Despite that broad availability, however, less than half of these premises have actually adopted an NBN connection — so while the service may be approaching readiness for the average Australian, it seems the average Australian isn't quite ready for the NBN. **HD**



'Slow and expensive' internet is inhibiting Australia's digital readiness

Even further Down Under.

Australia's ranking in global net speeds hasn't changed since last year — according to Akamai's State of the Internet Report for the third quarter of 2016, the country ranked 50th in the world. The NBN rollout was supposed to improve matters, but as of June this year, Australia was still at No.50, behind Kenya.

A new report — the World Economic Forum's Network Readiness Index — corroborated Akamai's findings after surveying 139 countries. According to the report, Australia — which ranked 18 in 2014 and managed to jumped up two places in 2015 — fell back to 18th spot in digital readiness in 2016. The affordability of fixed broadband and consistently slow connectivity are the reasons cited for Australia's slip in global rankings.

According to the Digital Australia: State of the Nation, The 2017 Edition report released by professional services group EY Sweeney, "As the world's 13th largest mixed-market economy, boasting a AAA rating from all three global rating agencies, Australia should be further up the global digital rankings. However, Australia remains caught in the shadow of other advanced nations." **Sharmishta Sarkar**

Australian laws will force tech companies to hand over encrypted messages

A BACKDOOR BY ANY OTHER NAME?

Prime Minister Malcolm Turnbull recently announced the government's intent to introduce new legislation that would force (or "oblige") social media and messaging companies to decrypt secure messages for the sake of national security.

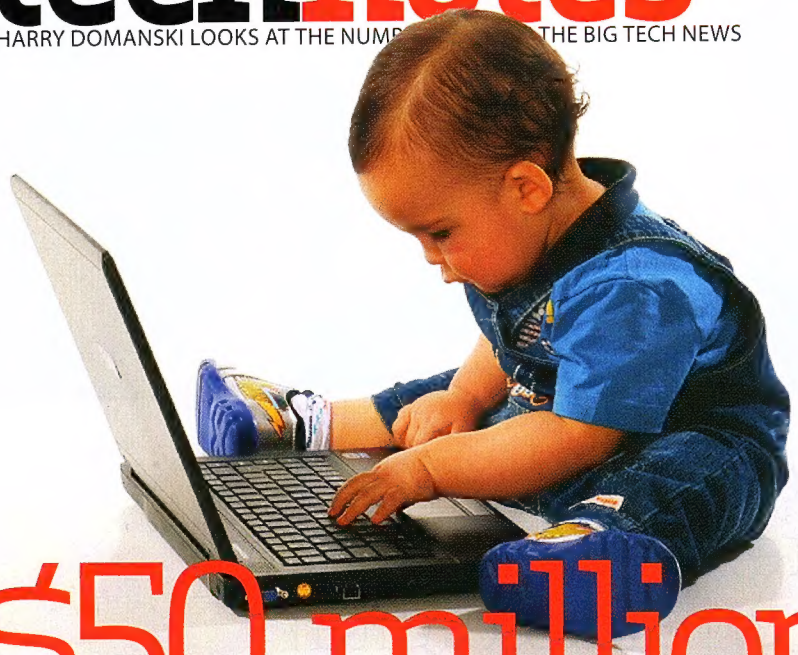
The proposed laws have been, at least in part, modelled off the current UK law on the issue — officially known as the Investigatory Powers Act, but often derisively referred to as the 'Snooper's Charter' — which is similarly designed to negate the 'safe spaces' that encryption creates, which can be used by terrorist and criminal groups to communicate.

Unsurprisingly, there has been backlash against proposals of this nature, with Facebook (responsible for the encrypted messaging app WhatsApp) stating that, while they "appreciate the important work law enforcement does ... weakening encrypted systems for them would mean weakening it for everyone."

Prime Minister Turnbull has stated that enforcing these laws does not have to involve building a backdoor into any of these secure apps (ie, a flaw in the encryption able to be exploited by law enforcement), but the problem of how this access will be granted without such a mechanism is yet to be explicitly addressed. **Harry Domanski**

technotes

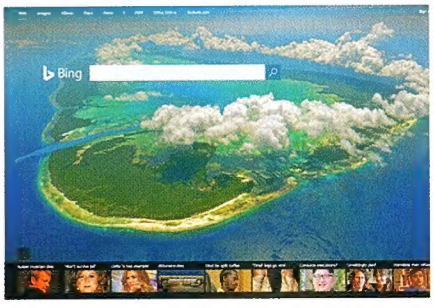
» HARRY DOMANSKI LOOKS AT THE NUMB[illegible] THE BIG TECH NEWS



$50 million

AMOUNT OF MONEY CANADA IS SPENDING TO TEACH KIDS TO CODE

Canadian officials have recently announced that the government will spend $50 million AUD funding a new a initiative that aims to teach kids to code. This program, titled CanCode, plans to dish out the money to certified non-profit organisations that will ideally help over half a million Canadian children (from kindergarten up) to learn digital skills. The country's Minister of Innovation thinks this will "teach young people how to work as a team to solve difficult problems in creative ways" and help produce "the next great innovators and entrepreneurs".



12%

BING'S MARKET SHARE IN ONLINE SEARCH DOWN UNDER

Microsoft recently released some stats on the use of its search engine, Bing, revealing a global market share of 9% as well as more detailed information for some other world regions. With a 12% share, Australia isn't too far off the average and mirrors a lot of the Asia Pacific region, although the search engine seems to do its best in the US and UK with surprisingly high market shares of 33% and 26%, respectively. We guess that begs the question: Is there something us Aussies are missing, or are we actually more savvy than our other Western friends?

0.97%

PERCENTAGE OF WINDOWS MALWARE THAT'S RANSOMWARE

Despite all the attention that ransomware has been getting in recent months, not to mention the apparent chaos that it's caused around the globe, a study by antivirus testing group AV-Test has found that this type of threat only accounts for 0.97% of all Windows-based malware. Trojans, worms and viruses in general made up the vast majority, with 23.74%, 25.44% and 37.60%, respectively. This study only looked at malicious programs from 2016, but even if that ransomware figure triples in 2017, it will still be relatively rare.

113,000

AMOUNT OF AUSSIES CURRENTLY WORKING IN THE APP INDUSTRY

As the smartphone and tablet app industry continues to bloom, Australians are keen to ride the wave, too, with a whopping 113,000 of us employed in the industry — an increase of 11% over last year's figures. According to the report these figures came from (The Rise of the Australian App Economy by the Progressive Policy Institute), these 'App Economy' jobs comprise 0.9% of the entire Australian job market, which is higher than Europe's 0.8% and not far from the US's 1.1%.

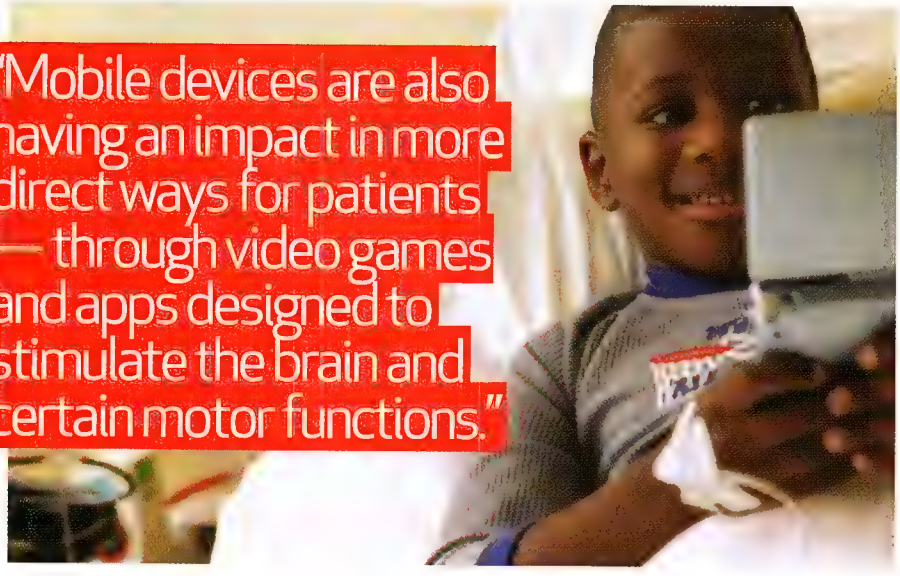
2 billion

MILESTONE REACHED FOR THE AMOUNT OF MONTHLY ACTIVE FACEBOOK USERS

Mark Zuckerberg's social media empire has been growing alarmingly quickly since its launch 13 years ago, with the company hitting a billion active users less than five years ago. Facebook has now doubled that figure and is currently sitting pretty at 2 billion active monthly users which, for some context, is more than a quarter of the world's population. Meanwhile, YouTube is sitting at 1.5 billion, Instagram at 700 million and Twitter at 328 million. ■

techbrief

» CARMEL SEALEY WADES INTO A CURRENT NEWS TOPIC TO TAKE A CLOSER LOOK



"Mobile devices are also having an impact in more direct ways for patients — through video games and apps designed to stimulate the brain and certain motor functions."

Apps and games, just what the doctor ordered

How video games and apps can help get people back on their feet.

The emergence of mobile devices has helped many industries, especially for medical professionals. Where hospitals and doctors' surgeries were dominated by paper filing systems, we're now seeing the transition to digital records, which are more readily available through mobile technology, such as wheelable workstations or 'personal digital assistants' (PDAs), smartphones and tablets. The development of software for these devices is rapidly growing, enabling professionals to better access information, manage their patients and monitor their progress, as well as access educational tools.

Mobile devices are also having an impact in more direct ways for patients — through video games and apps designed to stimulate the brain and certain motor functions. Your humble reviewer has experienced first-hand the healing power of video games in a hospital as a child, and it seems as though the industry and the broader community are embracing the idea as well.

Charities bringing fun to the ward

Gamers Outreach, Extra Life and Child's Play are charities that help children better cope with hospital treatment by providing them with gaming equipment and games. Many children feel afraid in hospital, as the environment is unfamiliar, their parents cannot be with them the entire time and they're also experiencing pain from an injury or illness. Gaming proves a powerful distraction, allowing them to stimulate their brains, laugh, feel more comfortable and even to learn. Similarly, the AbleGamers Foundation works to bring gaming to those with disabilities, providing an online discussion hub.

Therapy in your pocket

Mobile technology can also help people with their mental health, with businesses like Talkspace bringing therapy to you whenever you want it. One of the main barriers to people who are looking for help is approaching someone they don't know (let alone trust outright) and overcoming that initial fear of being judged, so being able to access online therapy without having to meet someone face-to-face or even talk on the phone is a real boon. Using encryption to protect your conversations is just another way to ensure that whatever you need to say or hear is for your ears and eyes only.

Virtual reality and gaming helping to make rehab fun

Fight the good fight.

Last year, Samsung released Be Fearless — a project for its Gear VR device to help people, through apps and games, face their fears and slowly overcome them. Well, virtual reality is already helping people with physical rehabilitation therapy. After receiving feedback from patients, Newcastle movement therapist Rohan O'Reilly introduced VR to make therapy sessions more inspiring and help with motivation. As he saw it, if you enjoy your rehab, you're more willing to try certain exercises and you become more emotionally connected to what you're attempting, resulting in patients trying harder and actually looking forward to their sessions.

Patients who have suffered strokes are often left with reduced mobility in their arms and hands, impacting on their independence. More research is being dedicated to how video games and virtual reality can help in post-stroke rehabilitation by heightening participation and excitement. VR and gaming consoles can also be a cheaper alternative to many other physical therapy equipment options, not to mention more convenient for the home.

Additionally, since the late 1990s, 'serious games' (ie — games that are created with a 'deeper' goal than to just entertain, such as teaching problem-solving skills or increasing physical activity) have been used with children with cerebral palsy to help increase their motor skills. While this is an area that requires further research, it's an exciting prospect, that games could help the medical industry in this way.

technotes

» GEAR WE WANT

APPLE HOMEPOD

Apple promises its Siri-powered speaker assistant will be a good roommate.

US$349 | WWW.APPLE.COM/AU/HOMEPOD

AI-powered smarthome assistants are some of the hottest tech at the moment, with Google releasing its Google Assistant-powered Home speaker locally in July, Amazon confirming that it intends to bring the Echo Down Under, and Apple's revelation of the HomePod at its developers conference in June. With availability for the latter slated for December, there's still a bit of time before you can grab this Siri-equipped smart speaker, but its well-positioned parent company is claiming that its existing assistant capabilities, broad software integrations and the HomePod's high-quality internal speaker array will bring high-fidelity audio to a 'Siri-smart' speaker. **JB**

OPTOMA UHD 60

The first actually-affordable 4K projector.

US$1,999 | WWW.OPTOMA.COM

While it's possible to spend up to $50,000 for a 4K projector from the likes of Sony, the entry-level UHD projector market has bottomed out at around the $5,000 mark since economical models first arrived about a year ago now. That's about to change however, with US projector-maker Optoma launching a cinema-quality 4K projector priced at US$1,999. There is a bit of trickery involved in bumping up of the pixel count on this unit, but the early reports are that the 24fps quality is visually on par with its more expensive predecessors. With a 1,000,000:1 contrast ratio, 3,000 Lumens brightness, 140-inch projection size and the enhanced HDR10 colour gamut, this projector has a lot going for it. **JB**

MAGC

The meeting point of USB Type-C and f-ing magnets! (How do they work?)

US$39 | MAGC.IO

There are a number of worthwhile upgrades in Apple's new MacBook Pros, but its conversion to charging via USB Type-C means it loses out on the easily-detachable MagSafe power connection that Apple used on its predecessors. MagC is a Kickstarter that promises to turn a newer MacBook's USB Type-C socket into a MagSafe-like power port for US$39. This clever unit doesn't lose out on the throughput or bandwidth speeds of the original connection, and comes with a one-year warranty, so it's not surprising that the project had more than four times the US$8,000 funding goal, with 24 days remaining at the time of writing this piece. **JB**

NEST CAM IQ

The security cam that outsmarts the rest.

US$299 | NEST.COM

What makes it so smart? Well, the IQ offers 24/7 live streaming, night vision and high-powered video tech that Nest calls Supersight, which combines a 4K sensor with HDR and intelligent imaging, all backed by a hexa-core Qualcomm processor. It also uses facial recognition tech to tell the difference between who's welcome in your home and who isn't. You can programme Nest Aware (monthly subscription fee required) with the faces of anyone who needs regular access to your home without setting alarm bells ringing. The Cam IQ will notify you when family members or friends have arrived home. If it spots an intruder, it will automatically zoom in and follow their activity, pinging an alert to your smartphone. It will then use a powerful, loud speaker to scare off said undesirable. It also uses noise cancellation and echo suppression on the HD Talk and Listen audio feed, so you can hear intruders clearly – and they can hear you when you tell them you've called the police.

ESSENTIAL PH-1

A new Android phone that aims to simply your life.

TBC | ESSENTIAL.COM

The Essential PH-1 is the debut smartphone from Android co-creator Andy Rubin's Essential company. The handset is made from ceramic and titanium, and has a 5.71-inch 2,560 x 1,312 QHD edge-to-edge display, which Essential calls the Full Display. There's a slim bezel at the bottom of the phone, with a cut-out at the top for the front-facing camera. At the back, there's a fingerprint scanner and a rear camera. According to Essential, the PH-1 has the world's thinnest dual-camera system for a smartphone. There's an 8MP front-facing camera and dual 13MP f/1.85 rear cameras with one monochrome and one colour lens; the two-lens setup works to capture up to 200% more light than traditional smartphone cameras. There's a 3,040mAh battery inside, which is bigger (just) than the Samsung Galaxy S8's, and the PH-1 supports fast charging via USB Type-C. Pony up some extra cash and you can buy a slick charging dock with magnetic connector. A fast Snapdragon 835 chipset powers the thing, with 4GB of RAM. There's also 128GB of storage. As we go to print, the PH-1 is available in America, with AU availability to be announced.

LOU BOARD 3.0

But will they be legal to ride in Australia...?

US$990 | LOUBOARD.COM

The silent Lou Board electric shortboard, fitted with motorised wheels, is designed for commuting and weekend cruising. There are three models, but it's the 3.0 that's got us itching to ride – silent dual motors and a 35v 2Ah battery dish out 3kW of rider-propelling power. The companion app limits speed for newbies, troubleshoots technical issues and can monitor current speed and battery temperature. With the Lou Board 3.0, you can cover a 25km round trip at 35kph after a two-hour charge. Heading uphill? The brawny board will shoot up those 20-degree inclines, no sweat. And don't worry about the battery running out mid-route – Lou works as a regular skateboard, too, so a drained battery doesn't mean game over. You'll just need to use your legs like the good old days. They're available to pre-order now.

tech notes

» EPINIONS

THE KEYS TO GOOD TECHNOLOGY

While I'm glued to the screen of my phone and laptop as much as any another *APC* reader, there are moments where I just have to take a step back after reading something and think, 'What? Does the world really need this?' I read recently about a hotel that is trialing doing away with keycards to simply sending a code to your phone, so you don't even have to visit reception. While this may solve the problem of having to reach your hotel within reception hours to check in and get into your room, what if your phone battery dies?

My husband recently proposed that we upgrade our front door to include a smart lock that unlocks automatically upon sensing your phone in the close vicinity. In theory, this sounds really cool and futuristic and everything, but why does everything have to go down the road of being upgraded by technology just because it's possible? Besides, most of these 'smart locks' look really big and clunky, so why can't we just skip this midway tech altogether and go straight to simply scanning people's retinas or fingerprints instead of forcing people to have their phone on them all the time (which isn't as handy as having a single key in your pocket when you go out for a run, by the way)? This is all trivial, since I'm sure our strata company won't allow us to diddle with our front door anyway... but it does pose the question: Just because it *can* be done with tech, why is it assumed that it's somehow better and that it *should* be done?

Ruth Higgins

SILVERLIGHT VS FLASH FOR VIDEO STREAMING

Why is it that most streaming services use Silverlight instead of Flash? When you compare the video quality and data rate, Flash is far superior. As an example, I've included two cropped video frames with this letter – the first from ABC iview (Flash) which used 350 MB for 45 minutes the second from Foxtel Go (Silverlight) which used 650 MB for 45 minutes. The Flash frame is sharper and uses less data and, on a Windows 10 PC, both use the same memory and PC cycles.

Carl Francis

"When it comes to streaming video, both Silverlight and Flash are essentially just the 'envelope' that the 'letter' comes in..."

Flash — ABC iview

Silverlight — Foxtel Go

Ed replies: The specific streaming technology used might not actually be the culprit here, Carl – it's more likely this is a case of the encoding settings of the original videos being quite different. There are all sorts of things that control how a video looks after it's been re-encoded from its original source – its average bitrate (and whether that's variable or constant), the resolution it was encoded at and the video codec used all have a significant effect on a digital video's final appearance.

Moreover, when it comes to streaming video, both Silverlight and Flash are essentially just the 'envelope' that the 'letter' (ie, the video) comes in – they're a delivery mechanism, rather than the message itself. So rather than being a streaming-technology issue, we reckon this is more likely a case of some streaming services better optimising their video in the first place. ■

APCMAG@FUTURENET.COM

Come on, have your say!

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Newsflash: Politicians still clueless when it comes to tech

Shaun Prescott can't help but shake his head over the continuing government push to obtain backdoors to encrypted systems.

The Australian Government is still hell-bent on gaining access to heavily-encrypted messaging services such as WhatsApp, with the announcement of new laws that will require companies to hand over encrypted data if necessary. While it's a step back from the earlier proposed legislation, which would have required a backdoor to be installed in any encrypted messaging software used in the country, the question of whether the Australian government even actually understands what it's doing is another problem entirely.

Chief among those in parliament who appear to have a lack of knowledge around encryption is the PM himself, who caused quite a stir last month during a press conference when the laws were announced. When asked how the government hopes to deal with encrypted data that often not even platform-holders are capable of deciphering, the ex-OzEmail chairman had this to say: "Well, the laws of Australia prevail in Australia, I can assure you of that." Turnbull continued: "I'm not a cryptographer, but what we are seeking to do is to secure their assistance. They have to face up to their responsibility. They can't just wash their hands of it and say it's got nothing to do with them."

The problem with this is that the Australian law isn't a supernatural force capable of solving enduring cryptography challenges that mere human geniuses cannot. And while Turnbull's comments may just be mere bluster, it does demonstrate how oblivious most Aussie politicians are in the field of information technology. You only need look at how the NBN rollout has transpired over the years.

Perhaps sensing that he sounded like a bit of a dolt, Turnbull later said that he hoped on moral grounds that companies using encryption would assist the government. "I am not going to get into hypotheticals. The important thing is to recognise the challenge and call on the companies for assistance. I am sure they know morally they should. ... They have to face up to their responsibility," he said.

Whether you agree that governments should be able to request access to encrypted messages is somewhat beside the point. While Turnbull and his colleagues on both sides of the aisle can't be expected to know all the intricacies of complicated matters such as encryption, they should know enough to speak confidently about it in front of journalists. And they should know enough to confidently create policy around it. Having met with strong resistance to the 'common backdoor' approach to accessing encrypted platforms, the government is trying to fit an anvil-shaped block through a tiny circular straw.

There is hope that the media's shaming of Turnbull for his bluster will force him to, maybe, read a book or talk to an expert. But let's wait and see. ■

END USER

Share your stories!

If you have an interesting story about technology users, their experiences and the issues that affect us all (whether funny or serious), email us at **apcmag@futurenet.com**. All correspondence becomes the property of *APC* and is subject to editing. Letters must include writer's full name, street address, suburb, state and phone number to be considered for print publication. Address and phone details will not be published.

Windows 10's next big step

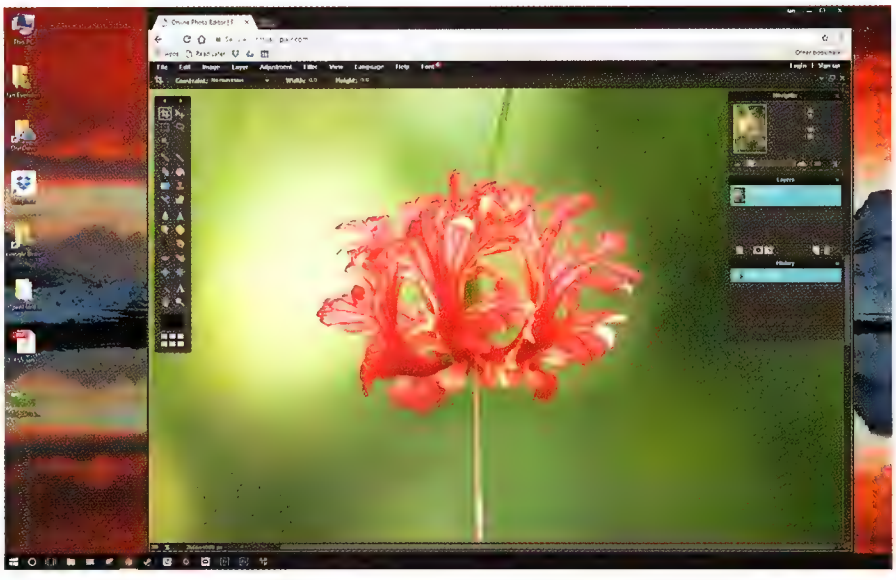
The next major version of Windows 10 will be heading your way this spring. Here's everything we know about the Fall Creators update so far...

Are you ready for another major Windows update to come your way? Microsoft has recently announced the Fall Creators Update, due in September (our spring, yes). Regular Windows watchers will note that the 'Creators Update' part of the name sounds familiar. That's because there has recently been a Creators Update released for Windows 10. You have probably got that on your PC now or, if not, you will very soon.

These kind of biannual-ish updates are now the norm for Windows, it seems; Microsoft is showing no desire to jump to Windows 11, so instead it's updating Windows with new features all the time, including the new Paint 3D app.

So why is the name so similar to the update just released? Our theory is that the original Creators Update wasn't as creative (or as well received by creators) as was hoped. And, in turn, part of this could be that hardware partners will have mixed-reality headsets available for the public to buy by the end of the year – when this update will be hitting PCs.

Then again, maybe there will be some juicy new creative hardware this spring to follow up on the wonderful



Surface Studio, which will reinforce the message that the update is for creators. Surface Studio is now fully available in the UK, as is the new Surface Pro and the Surface Laptop, unbelievably the first proper laptop that Microsoft has created.

Be warned: we don't have anything like complete details of what will be in the update yet, what follows is just a taster of what's to come. We will, of course, keep you informed of any changes to the Fall Creators Update over the next few issues – and will take an in-depth look when it's finally released in our spring.

One change you're likely to notice straight away are design cues taken from Microsoft's Fluent Design System (**fluent.microsoft.com**). This will create a more fluid experience across multiple devices, while further taking Windows

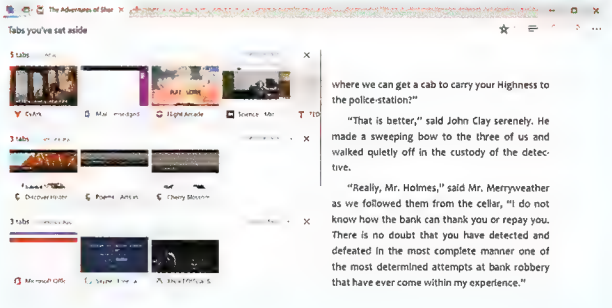
Pick up where you left off

When the Windows 10 Fall Creators Update arrives in September, Microsoft's virtual assistant Cortana will help you pick up where you left off on any device, even as you switch from PC to phone.

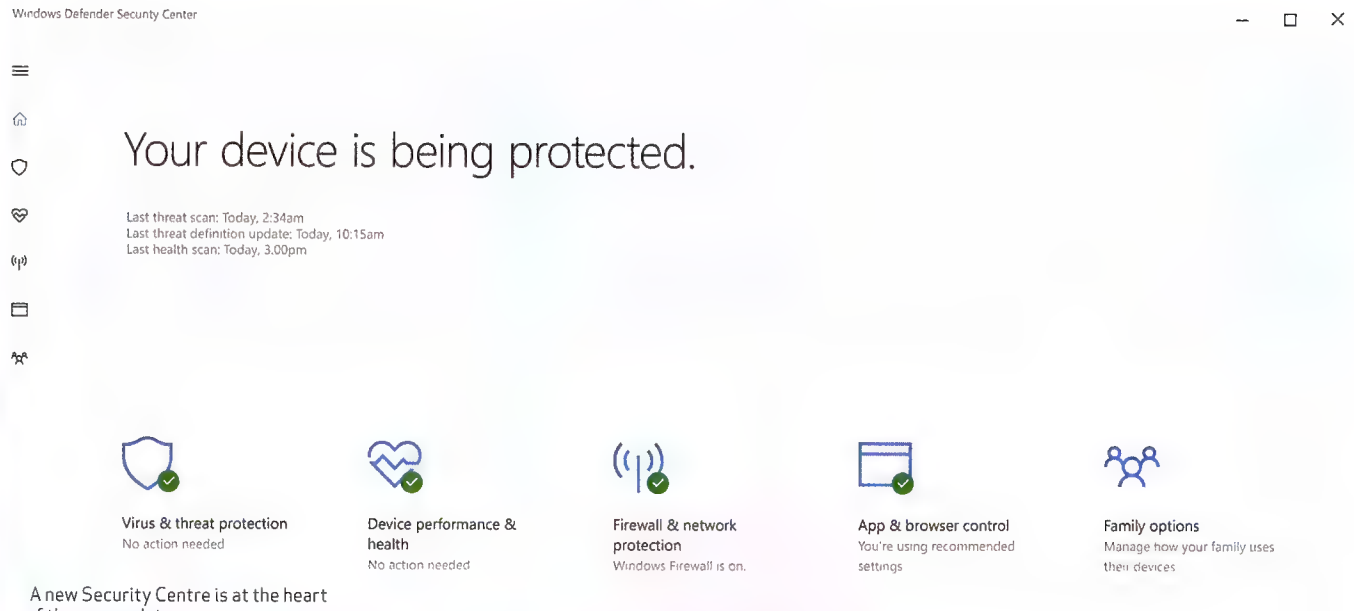
Although most of us aren't talking to our PCs in the way Microsoft would like us to, Cortana's artificial intelligence is useful in a multitude of ways other than speech. So for example, it will be able to predict which apps that you might tap or click on next, depending on what you've been doing on your phone.

Switching between apps in Windows 10 has always been easy thanks to Task View, but in the new update there will be a timeline aspect to it as well — so you can effectively get back to where you were at a point in the recent past.

Which apps you use — and when — will be tracked within a new section of Task View called Timeline, so if you need to go back to the windows you had open during your 2pm meeting yesterday, for example, Timeline will find and open them for you. And because Cortana works on iOS and Android devices as well, it will also be able to suggest apps that you might want to use on your smartphone or tablet, as well as


Tabs you've set aside
where we can get a cab to carry your Highness to the police-station?"
"That is better," said John Clay serenely. He made a sweeping bow to the three of us and walked quietly off in the custody of the detective.
"Really, Mr. Holmes," said Mr. Merryweather as we followed them from the cellar, "I do not know how the bank can thank you or repay you. There is no doubt that you have detected and defeated in the most complete manner one of the most determined attempts at bank robbery that have ever come within my experience."

on your computer, and vice versa. So if you just used Word on your iPad, your PC will give you the chance to open the same app and file when you switch over to your PC — a feature called, appropriately, 'Pick up where you left off'. It's a similar idea to the 'set aside tabs' option introduced in the original Creators Update, which enables you to return to the web pages you had open during a previous browsing session.


Windows Defender Security Center
Your device is being protected.
Last threat scan: Today, 2:34am
Last threat definition update: Today, 10:15am
Last health scan: Today, 3.00pm
Virus & threat protection
No action needed
Device performance & health
No action needed
Firewall & network protection
Windows Firewall is on.
App & browser control
You're using recommended settings
Family options
Manage how your family uses their devices

A new Security Centre is at the heart of the new update.

"The Fall Creators Update will also allow you to pick up where you left off in apps on iOS and Android devices."

away from the Metro (Modern UI) design we first saw with Windows 8.

The Fall Creators Update will also include accessibility improvements, not least to Narrator, Windows 10's screen reading utility. It will feature a device learning mode, which will enable you to send a command from a keyboard, a touch or Braille display and give you feedback on what the command does (as opposed to just carrying it out).

Other moves to improve Windows 10's accessibility will include tweaks to make things easier for users with low levels of vision, including a more useful Magnifier which follows Narrator's focus and offers new options for smoother fonts and images – and the ability to zoom in or out using the mouse wheel.

IOS/ANDROID INTEGRATION

The Windows 10 Fall Creators Update will also include some rather excellent new features for those of us who don't have Windows Phones, which – let's face it – is most of us. One of the big features of Windows 10 Mobile was that it could use Continuum. This is a technology built into Windows 10 Mobile that essentially enables you to use a phone like a basic PC – you just connect up a keyboard and mouse using Bluetooth, as well as a monitor via your phone's USB connection and off you go.

When it's released in the autumn, the Fall Creators Update will also allow you to pick up where you left off on apps on iOS and Android devices – like in a Word document using Office. It will also include a cloud clipboard that will enable you to move stuff between different devices, rather like Apple's Universal Clipboard for iOS and macOS.

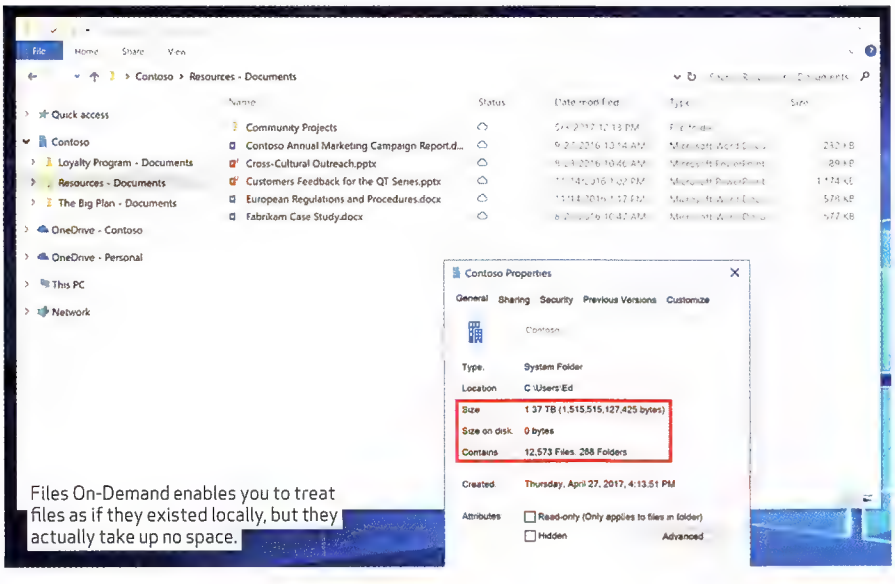
Microsoft bought awesome word prediction keyboard app, Swiftkey, (**swiftkey.com/en**) in 2016 and it sounds like cloud clipboard will be the first result of that acquisition.

One smart feature will be called Timeline – see the 'Pick up where you left off' box, far left, for details.

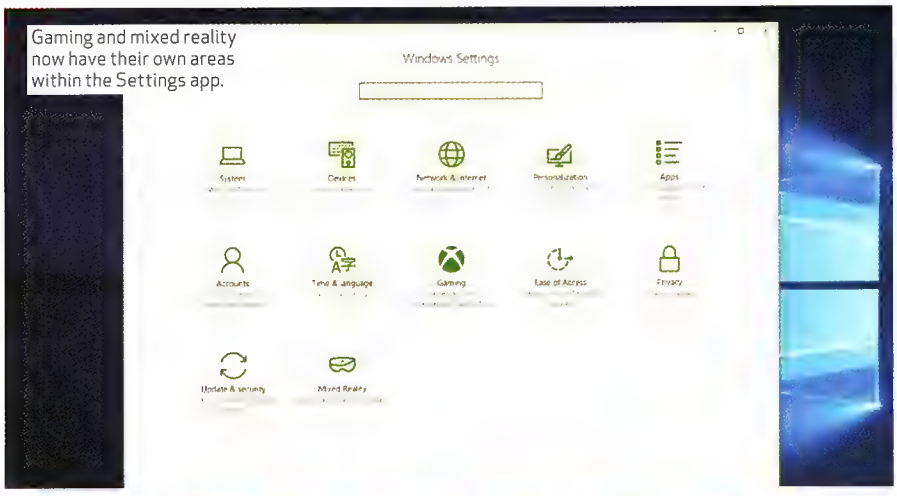
Another welcome change in the Fall Creators Update will be the addition of pro-level apps, such as Autodesk Sketchbook (**www.sketchbook.com**) to the Windows Store. This is, in part, explained by Windows 10 S, the new, super-easy to use version of Windows 10, which is aimed at students. The new version of the operating system relies exclusively on the Windows Store for apps, so any sign that developers are getting on board is welcome.

But's it's not all pro-level apps either. Microsoft is encouraging developers to produce universal apps for the Windows platform, even Apple. It's joining the Windows Store in the spring with a new version of iTunes.

The existing version of iTunes has been derided as one of the most resource-hungry and crashy apps ever to hit the Windows platform. And while recent versions have been much better in terms of these issues, it's welcome news that Apple is working on a completely new version. Windows users will get the complete iTunes



Files On-Demand enables you to treat files as if they existed locally, but they actually take up no space.



Gaming and mixed reality now have their own areas within the Settings app.

"Also coming soon is a new OneDrive feature called Files On-Demand."

experience, including Apple Music and the iTunes Store, as well as support for iPhone and other Apple devices on any Windows 10 or Windows 10 S computer.

Story Remix is another new app that will combine music, photos, videos and stories, enabling you to create new ways of sharing your photos and videos rapidly. You can also combine similar footage shot from different angles.

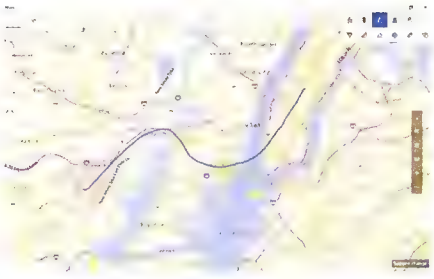
ONEDRIVE ENHANCED

Also coming soon is a new OneDrive feature called Files On-Demand. This will enable you to access all your files in the cloud from any device, without you having to download them to your PC or mobile device first. The good thing is that this won't change how you use your PC, since the files appear in File Explorer just like any other file on your computer, and you can open them from within other apps using the Windows File Picker. Files On-Demand works on both business and personal OneDrives. ■

Windows 10 S explained

Windows 10 S is a special new version of Windows 10 that made its debut on the new Surface Laptop. It's designed for those who value stability and security — particularly in education — over and above flexibility. That's because it only enables you to install apps from the Windows Store and so — according to Microsoft — will be more reliable over time. It's impossible to know whether that will be the case currently, of course, and it's also fair to say that Windows 10 Home and Windows 10 Pro are pretty stable as is, even after having a stack of apps installed on them. The main market for 10 S will be education, where it's desirable to lock down systems so that apps and programs can't be installed from random sources.

Windows Ink and Maps



1 GET DIRECTIONS

Windows Ink is also getting an update. Using a stylus, you'll be able to draw a line between two points in Maps (probably your start and end points!) and then get instant directions between those two locations. You will also be able to use Windows Ink's ruler tool to draw straight lines across your map.

2 GET GOING

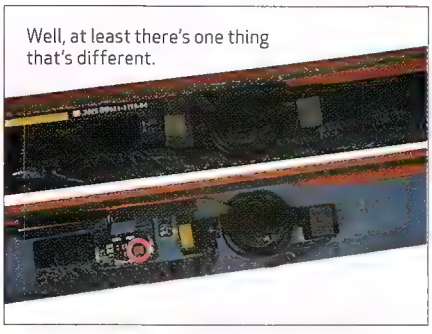
Here are the directions for our chosen route, which we can adjust if we wish. In the new update, Clipboard will enable you to copy and paste loads of stuff between connected devices across Android, iOS, and Windows; it could be a photo, map link or text. You can then paste wherever you want.

3 SHARE IT

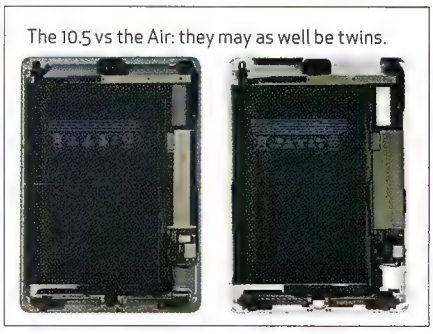
You can also annotate the map however you like and share it with others at will. Here we've drawn a map of a parade route — although it could be absolutely anything — which we can then share it with our buddies. You can use Windows Ink to add details in different colours, too, of course.

Apple iPad Pro 10.5-inch

We pull apart Apple's latest premium tablet.



Well, at least there's one thing that's different.



The 10.5 vs the Air: they may as well be twins.

The iPad team took a page from the iPhone SE playbook, and released what appears to be a throwback – an arguably under-specced tablet that takes aim at the education and enterprise markets. This iPad is supposedly reasonably priced, and powerful enough for professionals – but will it also earn high marks for repairability? Let's find out.

MAJOR TECH SPECS

- Apple third-generation 64-bit A9 processors, with embedded M9 motion co-processor
- 9.7-inch multitouch Retina display, with 2,048 x 1,536 resolution (246ppi) and non-laminated digitizer
- 32GB or 128GB of storage
- 8MP 1080p rear-facing iSight camera, and 1.2MP 720p front-facing FaceTime HD camera
- 802.11a/b/g/n/ac MIMO Wi-Fi and Bluetooth 4.2
- Touch ID fingerprint sensor, three-axis gyro, accelerometer, barometer and ambient light sensor

KEY FINDINGS

- It's time to start the iPad opening song and dance: Heat, pry, peek, repeat. Based on early reports, we're expecting this to be more Air 1 than 2: and this is why: The LCD and digitizer are unfused, and can be replaced separately. This is great news for repair. We needle a battery isolation pick betwixt the battery contacts and logic board to prevent any mishaps, stopping those electrons in their tracks.
- Flipping the digitizer over reveals the biggest change so far from the lookalike iPad Air: the addition of Touch ID, and its associated hardware. Thumbs up for fingerprint reading. Thumbs down for a harder repair, because the sensor is uniquely paired to its logic board at the factory.
- Moving on to the display, we don't spy any convenient manufacturer marks this time around. In Apple's press release announcing the iPad 5, it told us it comes equipped with a "brighter 9.7-inch Retina display". Our question is: brighter than what? It doesn't look that different from the Air 1's display. If they mean brighter than the Air 2, then that may simply be due to reverting to the unfused display design of the Air 1.
- So remember how we said this was similar to the first Air? We were serious – take a look at the photos above of the Air 1 and iPad 5. Not much has changed. Here, the Air 1 is dressed in space grey and has a slightly larger Wi-Fi module. The iPad 5 is in silver and... has less tape? They both pack the same 32.9Wh battery, beating the 27.6Wh iPad Air 2 and the 27.9 Wh iPad Pro 9.7-inch (all of which are outpaced by the Surface Pro 4's 38.2Wh reservoir).
- **Repairability Score:** 2 out of 10 (10 is easiest to repair). The LCD is easy to remove once the front panel is separated from the iPad, and the battery is not soldered to the logic board. We'll give it that. As in previous iPads, the front panel is glued to the rest of the device, increasing the chances of cracking the glass during repair. Adhesive holds everything in place. As with the Air 1, this ranks among the most difficult battery removal procedures we've seen in an iPad. The LCD has foam tape adhering it to the front panel, increasing the risk of shattering it during disassembly. You can't access the front panel's connector until you remove the LCD ■

About iFixit

iFixit is a global community of tinkerers dedicated to helping people fix things through free online repair manuals and teardowns. iFixit believes that everyone has the right to maintain and repair their own products. To learn more, visit: **www.ifixit.com**

Head to head: x86 vs ARM

In this new monthly feature, Jeremy Laird pits two competing techs in a head-to-head battle to decide which one is superior.

For pure performance, x86 has a clear edge.

Microsoft is at it again, rolling out an ARM-compatible version of Windows, this time with emulation capabilities to support legacy 32-bit x86 apps. How well that emulation works remains to be seen. But it begs the age-old question of how the rival CPU architectures compare, and what the future holds. Are ARM chips still the choice for mobile efficiency? Is x86 still the obvious performance play? Will the swarm of ARM chip makers devour every form factor currently dominated by x86? Or can Intel finally make a successful phone chip?

"Support for legacy code is another x86 advantage. All x86 chips must support the original 16-bit registers and instructions."

Round 1

RISC VS CISC

Remember when RISC versus CISC was the battle of the ages? Even today, Intel's chips and the upstart battalions of ARM processors align according to this paradigm, with x86 CPUs still CISC (or complex instruction set computing), and ARM representing the vanguard of RISC (or reduced instruction set computing).

But, in practice, it's a moot point. That's because ever since the Pentium Pro (and AMD's K5), x86 processors have really been RISC chips internally, and have relied upon a microcode translation layer to handle the x86 CISC instruction set. What's more, over time, x86 coding has coalesced around a relatively small number of commonly used instructions. All of which means that the old divides that saw x86 chips require relatively complex compilers, along with complex instruction scheduling and decoding hardware, and thus a higher transistor count for a given theoretical performance capability, not to mention limitations on instruction pipelining, no longer fully apply. CISC architectures, such as ARM, have likewise become more complex, with support for floating point math, virtualisation and hardware cryptography. In short, RISC versus CISC is no longer the crucial question.

WINNER:
It simply doesn't matter.

Round 2

PURE PERFORMANCE

If RISC versus CISC is no longer a crucial metric, there is still a divide between x86 and ARM that maps to similar territory: x86 remains a relatively complex instruction set; ARM relatively simple.

Take ARMv8, the latest ARM instruction set. All ARMv8 instructions are 32-bit (unless in 16-bit thumb mode), and with that comes the usual trade-off of fixed-length instruction encoding. On the other hand, x86 has variable length instructions and supports anywhere from 8 to 120 bits.

So x86 decoders are relatively big and complex, ARM decoders small and simple. That means x86 has an inherent advantage in terms of instruction density, while an arguably 'purer' CISC architecture like ARM runs up against instruction-dependent limitations when it comes to optimisations pertaining to pipelining and parallelisation.

In the end, it's complexity versus simplicity, and complexity wins in the pure performance stakes, provided you have sufficient transistors and power. In a modern desktop or server context, where transistor counts now measure in billions, and supplying ongoing power isn't a fundamental limitation, x86 still has a clear performance advantage.

WINNER:
x86, for now.

Round 3

MOBILE PERFORMANCE

What's good for x86's goose is also good for ARM's gander. By that, we mean that very much the same attributes and qualities that give x86 CPUs the edge in terms of pure performance play to ARM's strengths as a mobile processor.

Admittedly, x86 and ARM have converged quite dramatically. If you compare the likes of, say, Apple's recent CPU cores (in iPads and iPhones) with those of Intel, they look remarkably similar from the proverbial 1,000 feet.

Thus, whether it's x86 or ARM, you'll see the boxes alongside out-of-order execution, 64-bit memory addressing and even 6-wide instruction issuing checked for both architectures. What's more, in the real world, if you compare, for instance, the first Apple iPad Pro, with its dual-core ARM processor, to a 12-inch super-thin MacBook, and its dual-core x86 chip, you'll find they trade blows in basic performance metrics.

Remember, however, that this particular comparison is at the margins where x86 and ARM overlap – the most powerful ARM architecture versus the weakest full-power Intel Core chip. The more mobility you require, the more ARM's fundamental simplicity gives a power efficiency advantage.

WINNER:
ARM, with efficient ease.

"The more mobility you require, the more ARM's fundamental simplicity gives a power efficiency advantage."

Apple's latest ARM chips are more comparable to Intel's Core M processors.

Round 4

SOFTWARE SUPPORT

Much of this comes down to what kind of software you run. In theory, pretty much any app can be coded for either architecture. However, there are differences that give x86 an advantage.

For starters, part of the complexity of x86 includes support for instruction extensions that improve performance in certain workloads. We're dealing here with that middle ground between true general-purpose processing and fixed-function hardware accelerators.

Adding a small fixed-function engine to an ARM SoC, perhaps for video decoding, is simple. But the added complexity and transistor count of x86 processors allows for the addition of programmable vector instruction sets, such as MMX and AVX, that can be used for a broad range of workloads. It makes x86 more flexible for extracting a lot of performance from a wide range of code.

Support for legacy code is another x86 advantage. All x86 chips must support the original 16-bit registers and instructions. ARMv8 architectures, on the other hand, only support ARMv7 or AArch32 code across exception boundaries. Simply put, not only is there more existing x86 code to choose from, but x86 runs old code faster and better.

WINNER:
It's x86's greatest strength.

Round 5

FUTURE DOMINANCE

As things stand, neither x86 nor ARM dominates the whole landscape. For power, x86 has the edge, for efficiency and portability, ARM is the obvious choice. But will it always be this way?

For a while, it looked as though Intel wanted to insert x86 into every form factor and application. It created the Atom processor to take on ARM in phones and other ultra-mobile devices. Meanwhile, ARM chip makers, such as Qualcomm, have been increasing pure processing power and even creating products for server computers. Indeed, Microsoft ported Windows Server for ARM architectures, though it hasn't yet been released for retail, and it's having a second crack at supporting client ARM machines with a Windows OS.

That said, Intel has pulled out of the phone market, and narrowed its ambitions for Atom to high-performance tablet PCs. And ARM's server strategy is far from proven, as are ARM client PCs. Who would have guessed that Intel would fail so miserably in its efforts to move into ARM's territory? For the foreseeable future, the built-in advantages of x86 and ARM will make them very hard to budge from their respective strongholds.

WINNER:
A small edge to ARM.

And the winner is...

In the short to medium term, x86 remains the obvious pick for performance computing, while ARM is the easy mobility option. The further out you look, however, the less certain those assumptions seem. On the one hand, thanks to AMD's recent revitalisation with the new Ryzen processor range, the x86 landscape suddenly looks lively once more. Indeed, as we go to print, Intel has revealed an expansive range of additional Core i9 chips, with up to 18 CPU cores and 36 threads. That's a little bit crazy and a whole lot exciting. On the other, you could argue that it's a blip that goes against the general trend for more innovation and growth in the ARM market. What's more, thanks to ARM's more open approach to licensing, there are far more companies creating ARM-based CPUs and SoCs than the mere pairing of Intel and AMD on the x86 side of the equation. In the very long run, then, the inevitable encroachment of ARM on traditional x86 territory seems irresistible. But for fans of high-performance personal computing, x86 will be the architecture of choice for a very long time to come.

For $59, you can swap out the stock grey speaker grill for a Carbon or Copper base that'll add some drama to this subtle piece of tech.

SMART SPEAKER

$199 | MADEBY.GOOGLE.COM

Google Home

We adopted Google's new voice-controlled smart speaker to see if it can really pull its weight around the house.

Imagine this: You have a new roommate that turns the heater for you when you get home, warms up the coffee machine before you wake up in the morning, reads you to sleep at night and makes sure to turn off the bedside light when you're drifting off. This roommate shows patience when you yell, does their best to dig out answers to the obscure information you ask for, knows your personal taste in music and will play new songs that you might like. And while your roommate isn't always the sharpest, you know it's there to listen. And it'll even call you 'Supreme Leader', if you want. That roommate is the Google Assistant, and it lives in the palm-sized pod that is the Google Home.

PRETTY FLY FOR A WI-FI SPEAKER

Google Home wears a few hats, but its primary function is to act as a voice-controlled, internet-connected speaker. The Google Assistant can be called upon to play specific tracks from connected music streaming services like Google Play, Spotify or the radio-streaming service TuneIn, but if you don't have a subscription to any of these services, the Google Home comes bundled with six months free access YouTube Red, allowing you to cast music. If you happen to have a Chromecast Audio attached to an old receiver or your favourite speakers, you can also get Google Home to cast music directly to your living room. Sadly, at the moment you can't cast the same song across Google Home and a Chromecast Audio yet.

Of course, those audio streaming services aren't going to satisfy everyone. At present, you can't control any other services using your voice, but Google Home has all the tech needed to act as a Chromecast receiver, so it's just a matter of going into the third party app and clicking the 'Cast to Google Home' button. That does bring popular apps like Pocket Casts, TED, Plex, SoundCloud, CloudPlayer and Chrome into the fold.

THE STAMP OF A GOOGLE

Google Home is a smart little wireless speaker, so when you factor in that it costs $200 – notably less than many similarly-sized portable Bluetooth speakers – it makes you wonder how audio actually sounds. But this bowling pin shaped boom-box has one major advantage over it's portable compatriots... it's connected to power. The fact that the Google Home's single 2-inch driver doesn't need to be optimised to use as little battery power as possible means it's got a competitive edge – and they do punch well above their weight. It's no match for a dedicated hi-fi system, but for basic music and podcasts that you'll listen to in the background, it's perfect. Dual 2-inch passive radiators add more than enough punch at the low end, while the full-range driver adds warmth through the mid-tones and precision at the top end, and a reasonably-loud maximum volume with minimal distortion.

IT'S THE LITTLE INTERNET-OF-THINGS THAT COUNT

The audio element of Google Home arguably makes it worth the asking price on it's own, but playing tunes is really less than half of what the unit can achieve. This little penguin-shaped butler is also the best central smarthome hub we've yet come across. At launch, Google had already done a lot of legwork to make sure the Home can talk to any smarthome gear you might have. The search giant has added compatibility with Belkin's WeMo, TP-Link's Kasa, D-Link's Home, Alphabet's Nest, Phillip's Hue and Telstra's Smarthome products to

name just a handful. And though all these devices have different jobs and utilise different apps to make them work, connecting them to the Home smartphone app follows the same easy-to-navigate process – which requires opening the connected-devices tab, signing into the third-party app and authorising connection permissions, then simply importing the list of connected devices.

Every single device we connected during testing worked seamlessly under the command of Google Home, too. We were actually astounded to find that Belkin's WeMo devices were more responsive and consistent under Google Home's eye than when controlled through the company's own app. It's not just that everything works exactly as you'd expect, but it also puts all smart devices under the one roof and allows you to use your voice to control them, which is both significantly faster and requires far less effort than using apps. You will want to correctly name each device so that you can remember the audio description of, say, your living-room lamp over the downlights in the kitchen, but the Google Home app does let you group devices and allocate them to rooms, so you can "turn off all living room lights" with a single command. There's no way to conjoin multiple commands by just asking, but if you want to get really tricky, you can preconfigure custom phrases (dubbed 'Shortcuts' in the Home app), which, for example, will cast your Google Photo's album to the Chromecast and play soothing music when you say "How's the serenity?". Alternatively, you can connect it to the IoT rule-creating-service IFTTT (**ifttt.com**), to create any customisable trigger you can muster.

THE HAND OF THE KING

This overachiever has even more up its sleeve, though. You can dictate notes to Google's cloud-based note-taking application Keep, so that they're copied to all your devices and tap into Google's web-based Shopping List application to add items – we're assuming the latter will eventually get some kind of supermarket integration for voice-activated purchases, as this feature exists in the US already.

If you like to keep up with the news, you can sync the Home to your favourite Australian publications and prioritise them, so Home knows what headlines and news stories you want to hear first when you ask it to "give me the news". To top it off, it can read anything upcoming pegged on your Google Calendar and with the ability to sync up to six Google accounts and link them with a personal "OK Google" voice signature, you'll never have to worry about other members of your household peeking on your schedule.

There's still a few key functions that aren't available in Australia just yet – sending text messages or emails and reading step-by-step recipes for cooking being two we're particularly keen for – but we've been assured that they're on the way. The other limitation we found in testing was that the Home's effective microphone range is really only one room, and there's no prospect of adding additional 'satellite' listening devices – as you can with, say, Amazon's Echo Dots (which admittedly are also yet to officially arrive Down Under). You can yell at the Home from adjacent rooms, but the reliability drops considerably.

As far as downsides go that's really it, though, and there's a heap more useful things that Google Home can do right now that we haven't been able to cover deeply here, including providing dictionary definitions, local food and event recommendations, nutrition tips, timer, translations, travel info, unit conversion and weather forecasts.

The two-toned Google Home will always have a white tip, but you can swap out the subdued grey speaker grill on the bottom half for a jet black 'Carbon' or a polished 'Copper' colouring if you think it'll suit your house better, with either costing an additional $59. Personally, we liked the iceberg appearance of the white-on-grey that comes bundled, but each to their own.

While we weren't sure just what to really expect when we took in the Google Home – the first smart-assistant to land in Australia – it didn't take long at all for this handy helper to feel like a part of the family.

Joel Burgess

The single 2-inch full-range driver and dual 2-inch passive resistors combine to pump respectable audio for the device's price point.

Google Home is compatible with a range of existing smarthome devices including: Belkin WeMo, D-Link Home, TP-Link Kasa, Alphabet Nest, Phillips Hue and Telstra's Smarthome.

Verdict

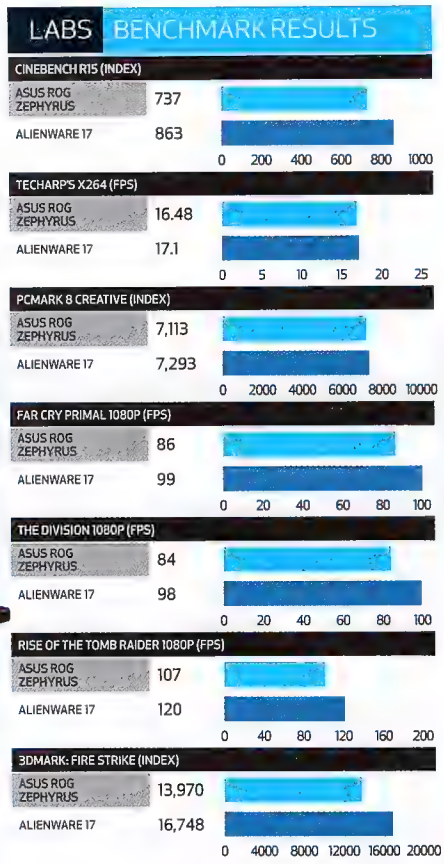
Features	★★★★★
Performance	★★★★½
Value	★★★★★

A well-priced smart speaker that adds clever software and IoT connectivity to make itself a helpful home assistant.

★★★★★

GAMING LAPTOP

$4,999 | WWW.ASUS.COM/AU


LABS BENCHMARK RESULTS
CINEBENCH R15 (INDEX)
ASUS ROG ZEPHYRUS 737
ALIENWARE 17 863
0 200 400 600 800 1000
TECHARP'S X264 (FPS)
ASUS ROG ZEPHYRUS 16.48
ALIENWARE 17 17.1
0 5 10 15 20 25
PCMARK 8 CREATIVE (INDEX)
ASUS ROG ZEPHYRUS 7,113
ALIENWARE 17 7,293
0 2000 4000 6000 8000 10000
FAR CRY PRIMAL 1080P (FPS)
ASUS ROG ZEPHYRUS 86
ALIENWARE 17 99
0 20 40 60 80 100
THE DIVISION 1080P (FPS)
ASUS ROG ZEPHYRUS 84
ALIENWARE 17 98
0 20 40 60 80 100
RISE OF THE TOMB RAIDER 1080P (FPS)
ASUS ROG ZEPHYRUS 107
ALIENWARE 17 120
0 40 80 120 160 200
3DMARK: FIRE STRIKE (INDEX)
ASUS ROG ZEPHYRUS 13,970
ALIENWARE 17 16,748
0 4000 8000 12000 16000 20000

ASUS RoG Zephyrus GX501VI

A thin gaming laptop that gives us our first look at Nvidia's Max-Q tech.

Thanks in a large part to the GTX 10-series GPUs – Nvidia's Pascal architecture – which offers excellent performance at lower temperatures than generations past, the latest crop of gaming laptops offer superb power in a shell that's thin and light, free from huge, bulky fans.

At Computex this year, Nvidia revealed its new 'Max-Q' design philosophy, which is centred around finding the right balance between power and efficiency, in order to put high-performance graphics cards into the thinnest notebooks possible. The RoG Zephyrus is the first Max-Q laptop we've tested, and it delivers on that promise of thin, quiet, powerful gaming, while measuring just 20mm thick when closed. To be clear, the Zephyrus' GTX 1080 is not as powerful as its desktop equivalent – or even one found in a (much bulkier) non-Max-Q laptop. In fact, it's about 15% less powerful than those mobile options.

What it loses out on in raw power, the Zephyrus makes up for in size and sound. It's significantly quieter than any gaming laptop we've seen. More impressively, all of these other 'thin-and-light's have mostly sported GTX 1060 (or below) GPUs, so even if the Zeph's GTX 1080 is underpowered compared to a desktop GTX 1080, it's still vastly more powerful than everything else called 'thin and light'.

To keep temperatures cool (and also stay quiet), the Zephyrus has a somewhat awkward keyboard layout that gives way to a rather ingenious cooling solution. The keyboard is located right at the front of the chassis – where the touchpad and wrist rests are normally situated – with the touchpad smooshed over to the right. This leaves the top half of the chassis – where a keyboard normally sits – free for a meshed ventilation area. A number of fans sit here, sucking in air to cool the GPU, before spitting it out the back through a gap that opens up when the laptop is open.

The keyboard layout is a little awkward to use (the Zeph comes boxed with an external rubber wrist rest to improve things a little), but is far from unusable. More than anything, it means you'll situate the Zephyrus a few inches further back on your desk than a normal laptop, which might be an issue if you lack desk real estate. Similarly, it's even more awkward to use on your lap, and not something we'd recommend.

The Zephyrus has all the standards of a current-gen gaming laptop: Intel Core i7-7700HQ CPU, 512GB SSD, 16GB RAM. It also features a 15.6-inch anti-glare wide-view panel, with a 1080p resolution, 120Hz refresh rate and Nvidia's G-Sync technology. Those final two bits are the most important, because aiming for a higher frame rate at 1080p is a much better use of GPU power than attempting to run games at higher resolution.

The Zephyrus outperforms the GTX 1070 laptop in gaming tests by about 5–10% but falls short of the full-size laptop or desktop GTX 1080 systems by 10–15%. But the trade-off in performance is more than made up for by the Zephyrus' sleek frame.

The laptop starts at $4,999, which sounds like a lot for its level of performance (by comparison, the RoG Strix GL502VS that it barely outperforms is only $2,999). But in this case, you're paying for the convenience of a sleek, tiny frame, and the engineering required to keep everything cool and quiet.

Bo Moore

Verdict

Features	★★★★★
Performance	★★★★½
Value	★★★

With a beautiful if unusual design, this is a thin, light and quiet gaming laptop with excellent performance.

★★★★½

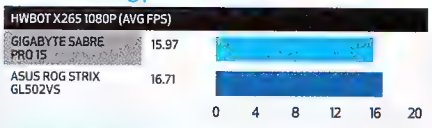
GAMING LAPTOP

$2,249 | WWW.GIGABYTE.COM.AU

LABS BENCHMARK RESULTS

General performance

Media encoding performance



Graphics performance

Battery life

Gigabyte SabrePro 15

A solid all-rounder that really sharpens the pointy-end of the gaming laptop market.

When it comes to affordable gaming laptops, there's an expectation that you'll settle for less-premium chassis materials, make a sacrifice in the overall design aesthetic and get bulkier and lower-end components. We were fond of Gigabyte's Sabre 15 when we tested it a few months back (see *APC* 441, page 28), as it managed to undercut competitors at this end of the market with minimal sacrifices.

So, naturally, when we got a glimpse of the new SabrePro 15 at this year's Computex, we weren't sure whether the professional portmanteau was purely nominal or whether the upgrade would bump up the price and encroach on Gigabyte's performance-focused P-series laptop range. Either way, we didn't suspect it'd be a particular standout. But here, Gigabyte has managed to take the best bits of its cheaper Sabre design and figuratively dip them in gold – well... slick black aluminium.

Underneath its subtly accented, stylishly vented and crafted brushed-aluminium chassis, the SabrePro 15 offers up a pleasingly deep-feeling, full-sized keyboard with 2mm travel distance scissor-switch keys. The good-looking but commonplace 15.6-inch 1080p IPS screen is underpinned by an Intel Core i7-7700HQ CPU, 16GB of DDR4 RAM and a combined total of around 2.25TB storage space. While the first two components here perform predictably well, marching out a solid score of 4,845 on PCMark 8's Home benchmark, the 2TB HDD is a bit of an unexpected bonus – it's double the size of what you'd expect at this price, and it's paired with a 256GB Samsung PCIe SSD (where Windows 10 is installed) that cranks out impressive sequential read speeds of 1,705MB/s and will push belligerently-fast boot times.

While the earlier Sabre 15 featured a somewhat conservative GeForce GTX 1050 Ti GPU, the SabrePro 15 bumps this up to the VR-ready 6GB GeForce GTX 1060. In terms of raw 3DMark benchmark scores, this equates to a 25–45% boost, depending on the test, which was consistent with our real-world benchmarks on *BioShock Infinite*, *The Division*, *Far Cry Primal* and *Metro: Last Light*, where the 1060 outperformed the 1050 Ti by 28–55%. For broader reference, the SabrePro 15's GTX 1060 GPU is still outpaced by higher-performance parts like the GTX 1070, as seen in Gigabyte's P57X v6; in *Batman: Arkham Knight* and *Tomb Raider*, the 1060 offers up 1080p Ultra scores of 71 and 156fps compared to the 1070's 113 and 213fps. This less-power-hungry GPU does allow the 56Wh battery to last around 2 hours in PCMark 8's demanding battery benchmark, though, which is a passable result.

The Gigabyte SabrePro 15 delivers an appealing mix of mid-range and higher-end components and manages to offer features we once considered exclusive to pricer units. As a bonus, the SabrePro 15 not only includes faster PCIe SSD storage but also packs an HDD that's bigger than anything else in the price range. While its 2.5kg body is a bit heavy, it's still light enough to cart about. The core components have been carefully considered and it comes in at hundreds of dollars under anything we've seen with comparable specs.

Joel Burgess

Verdict

Features	★★★★★
Performance	★★★★½
Value	★★★★★

A handsome unit that balances speed and price to be one of the best value for money gaming laptops to date.

★★★★½

WINDOWS 2-IN-1

$1,599 | WWW.SAMSUNG.COM/AU

Samsung Galaxy Book (12-inch, 2017)

A titillating but troubled 2-in-1 device.

The Galaxy Book, frankly, doesn't do a ton different from the Windows tablet that preceded it, but rather refines it. However, what Samsung's tablet arguably needed was a different design altogether. For every improvement made, there seems to be an almost equal detraction. The result is a tablet that's 'just fine' in construction and performance, but continues to lag behind its rivals.

It comes in both 10.6- and 12-inch varieties, with the 12-incher the most directly-comparable to the Surface Pro and also what we tested for this review. It starts at about $1,599. That price gets you a Windows 10 tablet housing an Intel Core i5 Kaby Lake processor, 4GB of memory and a 128GB SSD behind a gorgeous Super AMOLED touchscreen. The problem is that its materials don't scream worthiness of such an entry fee. For instance, while the build quality on the display is impressive, the tablet comes in a plastic frame – granted, the plastic feels plenty sturdy and smooth, giving off the illusion of aluminium from a distance.

Samsung did outfit the Galaxy Book with all sorts of niceties, like a top-oriented power button and volume rocker, and a rear-facing 13MP camera with a 5MP front-facing webcam. The included S Pen is light and is pleasantly difficult to lose with Samsung's included pen loop, which holds the matte grey plastic pen snugly. The keyboard cover, however, still doesn't cut it. There's nothing wrong with the feedback and travel depth – both are quite enjoyable, actually – but we experienced a few issues with its design. Firstly, it's not very comfortable when lying flat as a laptop; secondly, typing with the device on your lap feels as though its going to spill right out; and thirdly, figuring out the keyboard's various magnetised orientations feels like making origami. That said, the soft-touch plastic feels quite comfy to rest your palms on and is quite sturdy.

Power-wise, the Galaxy Book fights in the same ring as Microsoft's Surface Pro 4, but despite being slightly more powerful, this amounts to almost no difference in real-world use. Standard workloads will be just fine, but anything beyond basic photo editing will likely result in a trip to Lag City.

Anything you do on the Galaxy Book – whether it be write a novel or binge a series on Netflix – will look amazing. Samsung knows how to make an incredible screen. This display is just as colour-rich as the Surface Pro 4, if not quite as sharp.

It reported a PCMark 8 battery life score of 3 hours and 10 minutes; however, it performed far better at local video playback, lasting 7 hours and 32 minutes.

We like that the keyboard and S Pen are included in the box, unlike some key rivals. Plus, the screen is downright gorgeous, and the tablet is thin and light, making it excellent for portability. However, it falls short of truly contending with the king of 2-in-1 PC devices, the Surface Pro.

Put simply, there are better options out there at this price.

Joe Osborne

Verdict

Features	★★★★½
Performance	★★★½
Value	★★★½

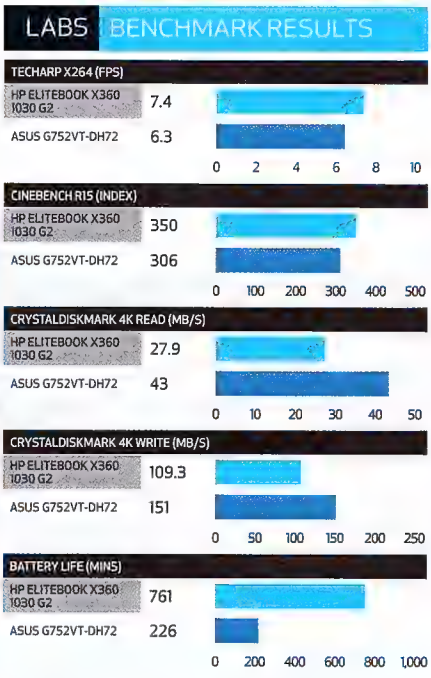
Not bad, but there just aren't many compelling reasons to pick up this 2-in-1 over similarly-priced competitors.

★★★½

apc RECOMMENDS

WINDOWS 2-IN-1

$2,299 | WWW.HP.COM/AU


LABS BENCHMARK RESULTS
TECHARP X264 (FPS)
HP ELITEBOOK X360 1030 G2 7.4
ASUS G752VT-DH72 6.3
0 2 4 6 8 10
CINEBENCH R15 (INDEX)
HP ELITEBOOK X360 1030 G2 350
ASUS G752VT-DH72 306
0 100 200 300 400 500
CRYSTALDISKMARK 4K READ (MB/S)
HP ELITEBOOK X360 1030 G2 27.9
ASUS G752VT-DH72 43
0 10 20 30 40 50
CRYSTALDISKMARK 4K WRITE (MB/S)
HP ELITEBOOK X360 1030 G2 109.3
ASUS G752VT-DH72 151
0 50 100 150 200 250
BATTERY LIFE (MINS)
HP ELITEBOOK X360 1030 G2 761
ASUS G752VT-DH72 226
0 200 400 600 800 1,000

HP EliteBook x360 1030 G2

HP's versatile convertible flexes its agile form.

While you can achieve some cleverness thanks to the extra flexibility of the screen hinge, you'll either use it as a laptop or as a tablet (on steroids). HP claims it actually has five modes, with 'presentation', 'media' and 'conference' rounding things out, but you'll rarely (read never) use these. Don't completely dismiss its overly athletic flexibility, though, because there's a lot to love in this svelte, versatile system.

Just to return to the convertible concept, they're pretty hard to sell, so we'll forgive HP its hyperbole of the EliteBook's five modes. Essentially, though: take a standard laptop, pop a fully rotatable hinge on it, and a touchscreen display, add a smattering of screen-orienting tech and you end up with a machine that can work in multiple ways. They're quite fun to use, especially when they're as light as this, and as pleasing to hold. You can do far more with them than with a normal tablet, too.

What really brought the machine into its own is the HP Active Pen. It may set you back another $60, but we see it as a necessity for anyone looking to make the most of the machine. There's nothing to stop you using your finger, but when it comes to taking notes and drawing annotations, the pen makes for a much more natural choice. Flipping the screen all the way around and turning the machine into a tablet genuinely makes sense when you reach for the pen. The fact it can be clipped to the side of the machine makes it a trouble-free accessory, too.

While we have been won over by the form factor, the same can't be said for the internal component selection. We're unashamed performance junkies here at *APC*, so anything less than a real Core i7 has us wary (especially at this price). The fact that this uses a Core i5-7300U – which is more like a Core i3 (as in it has only two cores and four threads) – means it's not really a high-end system.

We were momentarily hopeful about the M.2 SSD, but our benchmarks proved that this wasn't anything to get too excited about either. Raw performance isn't its forte. This is a work machine, so you'll search in vain for anything approaching decent gaming performance (we're not going to mark down a work machine for this, though).

There are a couple of counters that explain this component selection. First, the svelteness of the machine certainly helps win us back on side – it's a shade under 15mm and weighs 1.28kg. The low-power nature of the components means it doesn't get too hot either, so even at full load, it doesn't need excessive cooling. You can tell when it's working that little bit harder, but it never makes a nuisance of itself due to overzealous fans. It's worth noting that you have a couple of USB Type-A slots, too, which means you don't have to carry around an array of convertors.

Where the EliteBook x360 really excels, though, is in the stamina stakes. It will quite happily stick with you through a whole day of work and still be going strong long into the evening. We clocked in around 13 hours playing back HD movies. Not bad. This, coupled with the thin and light nature of the machine, makes for a great travel companion, even if it doesn't quite scream the kind of raw power that we're used to seeing here at *APC*.

Alan Dexter

Verdict

Features	★★★★½
Performance	★★★★
Value	★★★½

Awesome battery life, genuinely thin and light, quality screen and good connection options.

★★★★☆

ANDROID TABLET

$949 WI-FI, 32GB | WWW.SAMSUNG.COM/AU

Samsung Galaxy Tab S3

The world's first tablet with HDR video... that you can't really use — yet.

This is Android's first worthy competitor to the iPad Pro 9.7, with top-of-the-line specs to match. The Tab S3 is easily the best Android tablet you can buy right now thanks to its all-glass design upgrade, future-proofed HDR-ready display and included S Pen.

It costs $949, and while it comes with the improved S Pen in the box, the keyboard-case attachment is separate, costing an additional $189. Besides the Wi-Fi-only model, there's also a Wi-Fi + cellular option, which goes for $150 more at $1,099. When you add it all up, it borders on cheap laptop prices, and unlike its predecessor, there's no cheaper 8-inch version to give you a more affordable entry-level option. The S3 has also taken quite a while to arrive Down Under, landing some four months after its original US release date back in late March.

So was it worth the wait? Well, the Tab S3 touts a small but likeable design upgrade over the Tab S2. The best changes happen round the back, where the Tab S3 sports a new glass back panel in either black or silver, which looks and feels better than the rubberised plastic cover of the S2. HDR gives the same 2,048 x 1,536 Quad HD resolution higher contrast ratios and brighter highlights. However, there's a problem: there's not a lot of HDR video content currently available. It's being rolled out with streaming video services like Amazon Video and Netflix, but we weren't able to find any at launch — leaving us reliant on Samsung's HDR demos. It's definitely a jump in quality, but at the moment, you'd be paying for something only available further down the line — a hard sell for the average consumer.

The S Pen is an upgrade from the thin stylus we've been using on Samsung's Note phones and the Chromebook Pro. At 9.4mm thick, it's bigger and easier to hold than the previous S Pen and boasts four times as many pressure levels as the Apple Pencil. The keyboard attachment is a bit cramped but still useable, with decent travel when you hit the plastic keys. It has no function keys and is sorely missing a home button, but it folds up nicely, enveloping the tablet in a soft plastic cover on both sides.

At the heart of the S3 is the Snapdragon 820. This Qualcomm SoC is powerful enough to run all the latest 3D games, and it'll remain compatible with newer titles for some time yet.

Its 6,000mAh battery is slightly bigger than the S2's, but it's still undersized next to the 7,300mAh power pack in the 9.7-inch iPad Pro. Samsung says the S3 has enough juice for 12 hours of video playback, which is just about backed up by our testing. We ran a 90-minute HD video at nearly full brightness and the battery drained to only 87%. Plus, it took just under three hours to charge from zero to 100%.

The S3 has a 13MP rear camera that you'll hardly use. The quality is good for a tablet but your phone is always going to be better. More important to potential buyers is the front-facing 5MP camera for video chats, but this is merely adequate, and its low-light performance leaves something to be desired.

While Samsung may have closed the gap on the 9.7-inch iPad Pro with this solid entertainment-focused Android tablet, Apple still has better software and app support, meaning if productivity is your goal, you may want to opt instead for a slightly thicker laptop for around the same price.

Matt Swider

Verdict

Features	★★★★½
Performance	★★★★
Value	★★★½

It's the best Android tablet around, but you're paying a bit more money for tomorrow's features.

★★★★½

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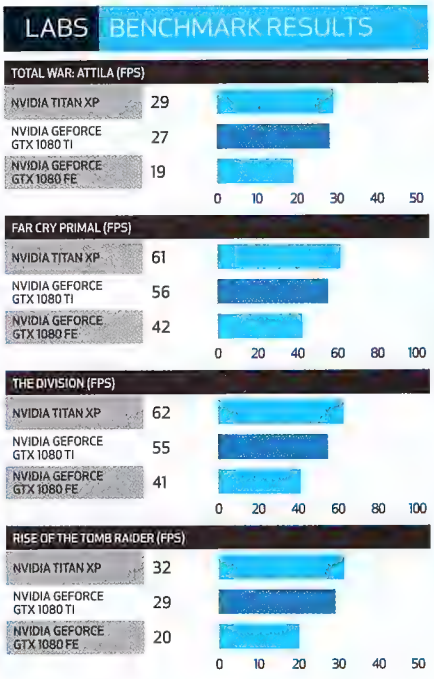
LABS BENCHMARK RESULTS
TOTAL WAR: ATTILA (FPS)
NVIDIA TITAN XP 29
NVIDIA GEFORCE GTX 1080 TI 27
NVIDIA GEFORCE GTX 1080 FE 19
0 10 20 30 40 50
FAR CRY PRIMAL (FPS)
NVIDIA TITAN XP 61
NVIDIA GEFORCE GTX 1080 TI 56
NVIDIA GEFORCE GTX 1080 FE 42
0 20 40 60 80 100
THE DIVISION (FPS)
NVIDIA TITAN XP 62
NVIDIA GEFORCE GTX 1080 TI 55
NVIDIA GEFORCE GTX 1080 FE 41
0 20 40 60 80 100
RISE OF THE TOMB RAIDER (FPS)
NVIDIA TITAN XP 32
NVIDIA GEFORCE GTX 1080 TI 29
NVIDIA GEFORCE GTX 1080 FE 20
0 10 20 30 40 50

GRAPHICS CARD

US$1,200 | WWW.NVIDIA.COM

Nvidia GeForce GTX Titan Xp

Nvidia's mighty GP102 chip fully unleashed at last.

This new Titan Xp finds itself in a family of at least three other high-performance graphics cards based on Nvidia's smash hit Pascal GPUs. We've had the GeForce GTX 1080 and its GTX 1080 Ti sibling, as well as the Titan X. Admittedly, only two of those are based on the bad boy GP102 graphics chip that sits supreme in the Pascal GPU lineup, but the point is that Nvidia has been cranking out big-money boards at a frightening rate over the last year or so.

That's not going to change, what with Nvidia recently giving a sneak peak of a board based on its upcoming Volta GPU architecture. The pace is relentless and Nvidia's rival, AMD, is struggling to keep up.

The Titan Xp is, quite simply, the GP102 chip fully unlocked and unleashed, all 12 billion transistors of it. Unlike the GTX 1080 Ti and Titan X boards, Titan Xp has all 3,840 CUDA cores and 240 texture units switched on. Like the Titan X, it also has all 96 render outputs enabled, and thus, the full meaty goodness of a 384-bit memory bus and 12GB of VRAM. Yum.

It also sports a Boost clock of 1,582MHz. That's identical to the 1080 Ti and a smidge quicker than the Titan X. It all adds up to 12.1 Tflops of processing power, and the title of undisputed heavyweight GPU champ. It's the most powerful gaming card ever.

If all that constitutes objective fact, how you view it subjectively is another matter. The Xp clocks in at US$1,200 (AU$1,500). On the one hand, that's aboutthe same as the outgoing Titan X, meaning you get a little more for the same price. On the other, the 1080 Ti is two-thirds the cost, at $990.

Thus, the additional $500 buys you about 7–10% more of everything: 7% more CUDA cores and texture units, 9% more render outputs and so on, compared to the 1080 Ti. At best, you're looking at 10% better performance — and, most of the time, not even that. That's not a big enough performance step that you will be able to feel the difference in games.

What's more, it's not as though the Titan Xp is infallible in terms of gaming performance. There is a long list of games that it can't render smoothly at 4K with high levels of anti-aliasing enabled. One might argue that lots of AA at 4K is somewhat moot, and that's probably true for 4K panels from 32 inches and down in terms of size. But on a big 40-inch-plus 4K panel, you're going to want to run AA, and sometimes, it will be AA of the performance-sapping MSAA variety. At that point, you're going to be pretty pissed that your US$1,200 GPU can't handle the heat, and you find yourself knocking it down to 2x MSAA, or switching it off altogether to get nice frame rates.

Not that you'll do any better with some other GPU. The Titan Xp is as good as it currently gets. And a lot of the time, it's very good indeed. Paired with a sub-4K gaming panel, the result is often ridiculously smooth gaming performance.

But the price creates expectations of something stellar, something completely different, an experience unlike any other. And that simply isn't the case.

If you absolutely positively must have the best, this is it. But the regular 1080 Ti — if such a thing as a $990 GPU can ever be called 'regular' — is a far, far better buy.

Jeremy Laird

Verdict

Features ★★★★★
Performance ★★★★★
Value ★★½☆☆

The fastest graphics card in the known universe, period. But is it worth the asking price?

★★★★☆

apc RECOMMENDS

34-INCH LCD MONITOR

$949 | WWW.PHILIPS.COM.AU

Philips 349X7FJEW

Philips throws a curveball at the display market.

Philips has a new monitor. This isn't exactly unusual – but what is a little out of the ordinary is the shape. The clue lies in the name, which is a potted description: the Philips 34-inch Curved UltraWide LCD monitor with FreeSync. (The 'short' name for it is 349X7FJEW, in true uninspiring product names fashion.)

Two things immediately strike you about the screen. First, the curve really does set it apart, and second, it's almost freakishly wide! At a native pixel resolution of 3,440 x 1,440, it's close to 2.4 times wider than its height, and it's a full 81cm from side to side [About half the height of our weeny Chief-Sub and Ed... – Ed]. Our rough calculations put it at about 111 pixels per inch, so it's not at all Retina-class. But you wouldn't sit as close to such a wide screen, so it feels pleasingly sharp.

So why have they gone curved? A curved display may seem unusual, but as displays get bigger, we've been noticing more and more problems with colour accuracy, particularly with certain LCD technologies. The more expensive IPS (in-plane switching) LCD panels work well even when seen from sharp angles, but the cheaper and common MVA (multidomain vertical alignment) form of LCD panel shows large colour and contrast shifts as your point of view moves from being flat-on to the screen. Put a large flat panel on your desk and you simply can't avoid this problem... unless the screen itself curves to help keep the whole surface more or less pointing right at you.

The curve is a smooth horizontal segment of a circle roughly 3m in diameter, so the best theoretical viewing spot is 150cm away. For active design work, it felt natural to sit half that distance away (around 75cm back), but the curve still did its job well. Images and even flat colours – the acid test for angle-of-view problems – were essentially even and consistent.

The manual says this display achieves 99.5% of sRGB. Our tests with a dataColor Spyder colorimeter showed 91%, so this isn't the ideal screen for really critical colour proofing. But the way the curve compensates for the MVA technology's quirks means it's actually better in real-world terms than comparable large, flat displays containing the same LCD panel type, regardless of sRGB scores.

Other specifications are just as we'd like: 15cm fingertip-driven height adjustment and the usual -5° to +20° tilt, two HDMI ports (one of them the 2.0 standard), one DisplayPort (not yet a core Mac concern, but one day...), four USB 3.0-level ports, and analogue audio in and out sockets.

Speaking of audio, this display has speakers that actually sound good in general use. They're not floor shakers, of course, but they are better than the offerings in most displays. Its huge width also gives a measure of stereo separation that's not at all expected in monitor speakers.

So... yes, the curve can feel odd at first, but don't knock it until you've tried it! What's really good about this screen is the way it allows for work to be shown really large, yet still have acres of room for tools and other windows. It's quirky, cool, and a much better display than we expected.

Verdict

Features	★★★★
Performance	★★★½
Value	★★★★½

Despite getting an imperfect sRGB score, this is a great display for visual work, and the sound quality is a bonus.

★★★★½

apc RECOMMENDS

34-INCH GAMING MONITOR

$999 | WWW.LG.COM/AU

LG 34UC79G

Can fewer pixels actually add up to more gaming fun?

Choose: pixels or performance. That's the new LG 34UC79G's core proposition. At 34 inches and with a 21:9 aspect ratio, you might expect LG's gaming panel to pack 3,440 x 1,440 pixels. Instead, it rocks a mere 2,560 x 1,080, a resolution we're more used to seeing on 29-inch superwide monitors.

The performance implications of that lower resolution are twofold. It allows the 34UC79G to crank out a 144Hz refresh rate over a standard DisplayPort 1.2 connection – 3,440 x 1,440 at 144Hz requires too much bandwidth. Then there's the minor matter of GPU performance. The more pixels you have to pump, the more load you put on the GPU. 3,440 x 1,440 is almost double the number of pixels of 2,560 x 1,080. Fewer pixels mean less load and more frames.

There are, of course, downsides. That's obvious the moment you fire it up. The coarseness of the pixel pitch is immediately apparent. As a corollary, you don't get a lot of desktop real estate, either, despite the generous 34 inches. The 1,080 vertical pixels feel especially stingy, and result in a lot of scrolling around web pages and other documents. At this price, there are far better options for pure productivity.

It's not the most stellar monitor when it comes to image quality. Yes, it's an IPS panel, but it won't blow you away with its punch and vibrancy. The backlight lacks zing, and the standard calibration crushes some details in darker tones. A little dither-related pixel fizz is also visible in gradients.

As for pixel response, it's good enough for the gaming remit and to cash in on that 144Hz refresh rate, but it's not going to scare the best TN panels. The gentle curve is also a little perplexing. If you like the idea of a curved monitor, you'll be disappointed here. If you don't, well, you won't want any curve at all. That said, the IPS tech does deliver fantastic vertical viewing angles and a nice colour balance overall.

If you have a powerful GPU, the 34-inch widescreen panel zipping along at 100+ frames per second is a sight to behold. In terms of response and fluidity, there is no beating a high-refresh panel. On a related note, if you have an AMD graphics card, LG includes support for the FreeSync adaptive refresh technology. There's also no doubting that adding pixels would somewhat undermine that sense of slick, lag-free performance.

Elsewhere, you get a good-looking display in terms of the design of the stand and chassis. The 34UC79G sports very thin bezels on three sides, plus a small chin along the bottom. As this is a gaming panel, it eschews the white-and-silver aesthetic for black and red. It's very nicely put together and assembles neatly.

The 34UC79G's on-screen control menu will likewise be familiar to LG fans. There are lots of options, though accessing them through the single joystick-style button on the base of the lower bezel can be tricky.

All of which makes LG's latest a niche proposition. As a productivity tool, it's limited by the relatively modest 2,560 x 1,080 native resolution. However, for gaming, the 34UC79G has to be worth a look. It's well priced for such a large IPS screen, and the 144Hz refresh and FreeSync support make for a fantastic gaming experience.

Jeremy Laird

Verdict

Features	★★★★½
Performance	★★★★½
Value	★★★★½

The 144Hz refresh rate makes for slick, responsive performance, and IPS has impressive colours and viewing angles.

★★★★½

apc RECOMMENDS

LASER MFC

$550 | KYOCERADOCUMENTSOLUTIONS.COM.AU

Kyocera Ecosys P5026cdw

A laser printer with distinct strengths.

Kyocera is targeting the small- to medium-sized business with this mid-priced colour laser printer. It's a step up from noisy and slow budget laser printers, and more efficient to run than inkjet rivals, making it suitable for a busy office that's reliant on paperwork.

This is strictly a no-frills printer, not a multifunction device, so there's no scanner or fax on-board and Kyocera advises against loading photo paper. What you can do is fill the 250-sheet paper tray with letter, or the 50-sheet multipurpose tray with envelopes, and print at a steady rate of around 26 pages per minute.

In terms of connectivity, you get integrated Wi-Fi alongside the usual square USB port, plus there's also a front USB port for inserting a flash drive – but no NFC compatibility. Kyocera has also ignored the trend for ever-larger touchscreen interfaces: a humble two-line mono LCD panel is all you get, with rudimentary cursor buttons to navigate through the primitive and awkward user interface.

The companion app Kyocera Mobile Print is a free download for iOS and Android, and it presents an attractive interface for printing wirelessly from your phone. However, you can't check the printer's toner levels from the app.

Plain text on A4 paper looks fabulous from this razor-sharp laser printer, especially when you introduce colour. These look bold and perfectly contained, and as colourful documents take exactly the same amount of time to print, it's tempting to drop in some red, yellow and blue text just to brighten things up a bit. ■ Jim Hill

Verdict

If you don't mind persevering with a tiny LCD, this is a fast printer with impressive print quality.

★★★★☆

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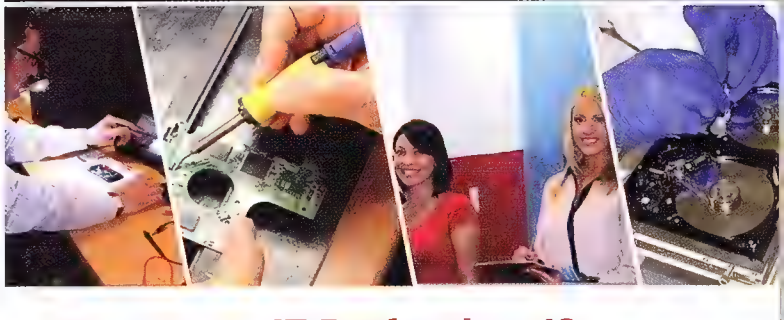

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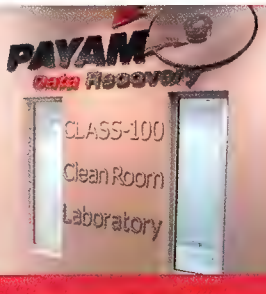

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$480 | ELGATO.COM

Elgato Thunderbolt 3 Dock

True one-cable convenience for your laptop.

The capabilities of Thunderbolt 3 enable this dock to deliver on the promise of convenience in a way earlier models couldn't; as you come and go, you only have to deal with one cable, which now carries power to supported USB-C/Thunderbolt laptops, video to a display and data to peripherals. On top of that, Elgato provides a utility that sits in the menu bar, from which you can safely eject devices with a couple of clicks.

This dock is capable of delivering up to 85W to a laptop, so you can use it even with 15-inchers. It took us a couple of days to appreciate that we no longer had to carry an extra charger in case our portable needed a top-up. However, the price is considerably higher than its predecessor.

In terms of ports, there's little change from Elgato's previous docks. There's a USB 3 Type-A port on the front, plus discrete 3.5mm ports for headphones and a mic. At the back are two more USB 3 Type-A ports, Gigabit Ethernet, a full-size DisplayPort and a passthrough Thunderbolt 3 port for daisychaining more devices. You can chain a 4K or 5K display, or even just a USB-C to Lightning cable; you'll need to connect your Mac for the latter scenario, or switch to using a USB-A cable with one of the older ports to charge without your Mac around. And if you have an older dock and don't have a high-res display, a Thunderbolt 2 adapter is cheaper.

Some models have more ports, but Elgato's latest is a sound investment, capped off with an app that shows consideration for how you'll use it with a supporting laptop. ■ **Alan Stonebridge**

Verdict

While it's more expensive than its older sibling, it's versatile and super useful — worth the price.

★★★★½

$130 | WWW.LOGITECH.COM/EN-AU

Logitech MX Master 2S

A multitasker's right-hand man.

Logitech is back with a fresh take on their multitasking mouse – the company's flagship, MX Master 2S. Stylistically, very little has changed with this new 'S' model from its predecessor.

The uber ergonomic form factor is still a wonder to behold and a wonder to be held, although it's really targeted at users preferring palm rather than claw grips, and only for right-handers. The graphite and light grey finishes are noticeably nicer than the black and stone of the predecessor's, and the return of the polygonal grip is a welcome aesthetic treat.

More significant changes include a bump from 1,600 to 4,000 maximum dpi, an increase in its rechargeable battery-life from an alleged 40 to 70 days and Logitech Flow. This is the key selling point and allows you to use the mouse for fluid multi-computer (and multi-OS) control on up to three devices. Once your devices are on the same network and have the free Logitech Options software installed (which doubles as your control centre for assigning its seven buttons and two scroll wheels), getting Flow running is fairly painless.

You'll be able to drag your cursor to the edge of a screen and have it appear on your neighbouring device's display, even allowing you to copy-paste files, text and images across Windows and Mac devices. This works exactly as it should and, for those that work across multiple machines, will pair nicely with one of Logitech's multi-device keyboards.

That said, you can snap up the regular MX Master 2 for around $80, so the upgrade to the 2S will only be worth the extra $50 if you can make good use of this Flow tech. ■ **Harry Domanski**

Verdict

The original MX Master 2 is still our favourite productivity-focused wireless mouse.

★★★★½

GAMING HEADSET

$150 | WWW.STEELSERIES.COM

SteelSeries Arctis 7 Wireless

Grown-up gaming cans with real quality.

No RGB lighting or tribal designs? Is this really a gaming headset? The Arctis 7 definitely does things differently. Central to this wireless headset's design is the 'ski goggle' headband, a length of adjustable elastic fabric that keeps the full weight of the model from imposing itself on your cranium and it delivers.

The earcups are finished with luxurious soft foam padding, affixed to a smart brushed aluminium headband. The other big selling point is lag-free wireless sound, and we'll admit to raising our eyebrows at the 15-hour battery life on the specs sheet, but our testing revealed it to be bang on.

Its 12m range is adequate; plus the wireless receiver is unobtrusive and setup is simple. Get a few cables involved, and you can use the Arctis 7 with your phone and consoles, too, although we'd have liked the 3.5mm cable to be a bit longer.

All controls are on the headset itself, including a volume scroll wheel, a chat mix wheel, mic mute and power buttons. A retractable mic sits on the left, and offers crackle-free VOIP. They're sensibly laid out and easy to find by touch.

However, when it comes to overall sound quality, it's slightly disappointing. SteelSeries fitted the same 40mm S1 drivers in this model as found in its higher-end headsets, but there's a muddiness here that no amount of preset-tweaking in SteelSeries's own Engine software can remedy.

This shouldn't put you off buying this headset, unless you're an audiophile or a competitive gamer, however. ■ **Phil Iwaniuk**

Verdict

Great fit with good battery life and solid wireless; however, the sound could have been better.

★★★★☆

GAMING HEADSET

$169 | GAMING.LOGITECH.COM/EN-AU

Logitech G433

Good audio performance, but compromises made to hit its price point.

You'll either love the mesh design of Logitech's new surround sound cans, or you won't. While Logitech's sports mesh design does help to keep the weight down, we didn't notice that they were especially breathable.

Built with 40mm drivers, these lightweight cans are capable of powerful bass, and that's important. But more than that, they deliver said bass along a relatively flat frequency response, which means it doesn't sound distorted at high volumes, or muddy up the overall sound.

The upshot is that you don't need to tweak any EQ settings manually or cycle presets for different activities in order to get a rich sound. Surround sound, provided digitally via DTX Headphone-X, provides a really wide and yet precise soundscape, which benefits both games and movies.

Logitech hopes you will use the G433s for all your consoles and mobile devices. The 1.5m cable enables you to hook this up to a PS4, Xbox One, or smartphone as a stereo headset. As for connecting to your PC, both USB and 3.5mm options are lavished upon you.

However, the mic has a bit of difficulty getting along with that non-retractable piece of bendy rubber it's attached to. Where's the retractable design? Our only other gripe is with the inline remote, which is small and awkward to use.

All that nitpicking still leaves two good reasons to buy this G433 headset – good value and solid sound. They're good boxes to check. There are no real deal-breakers in this package, but you should know not to expect luxury from the mic or controls. ■ **Phil Iwaniuk**

Verdict

Flat sound, strong surround and great versatility; just keep those caveats in mind.

★★★★☆

apc RECOMMENDS

PC CASE

$245 | WWW.BITFENIX.COM

BitFenix Portal

A sleek mini-ITX case inspired by a Valve puzzler, but is this a triumph?

The reasons to go ITX for your next build are manyfold – you reclaim valuable space, need fewer cans of compressed air to clean it and now, thanks to BitFenix's latest model, you can pretend you built a rig inside one of Aperture Science's portal guns or sentry turrets.

Perhaps the reason ITX isn't the dominant form factor is that you need to make compromises in the name of compactness. In the Portal's case, you need a smaller SFX power supply, and you're limited to a single GPU that takes up a maximum of two slots. We also recommend going as modular as possible with that PSU to minimise unnecessary cables, as this case's unusual interior design doesn't leave much room between PSU and drive bays.

There are benefits to that design, though. Rather than giving you access to the components via a removable side panel, BitFenix instead opts for a frame within a frame, so your entire build lives in an interior chassis that's accessible via a ball-bearing runner. It's also oriented so your graphics card lies 'upside down' at the very top of the case, visible through a perspex window on the top panel, although variants without the window are also available. In practice, this allows easy access to some usually hard-to-reach parts, and makes cleaning the PC much easier – just pull it out, bust out that air can and push it back in. It is a bit trickier for cable management, though. Certain cables can be tied in place on the interior frame, but those connected to the case itself – case fans, power button and so on – must have enough slack to allow the interior frame to run out past the exterior. It's a little like building a ship in a bottle in that way.

With a system built inside, the exterior features of the Portal are kept minimal to stay in line with that Valve-inspired aesthetic. A single power button graces the front panel, and along one side are two USB 3.0 ports next to inputs for a mic and headphones. At the rear, an additional bracket is fitted over the GPU screw holes on the case to allow easier access to the thumbscrews, and two large gaps at the top and bottom provide exit points for the hot air as it's pushed through from front to back, helped along by a single 120mm fan at the front and an 80mm fan at the rear. There's room for a 120mm radiator to be fitted instead of that 80mm fan if you opt for a more heavy-duty CPU cooling solution, though. Below the interior frame is plenty of room at the base for hot air from your PSU to disperse. For a case this size, which appears so solid and unventilated at first glance, airflow actually looks ample in the Portal.

But let's be honest, if this case piques your interest, it's probably due to its looks. In person, as it were, those looks hold up well. The aluminium panels are well finished and feel sturdy enough that transporting a built-up machine shouldn't do any damage, and it's nicely topped off with a black or white powder coat, depending on your taste. The only question mark comes in that runner design, which is fine for the initial build, but doesn't feel smooth or robust enough to endure repeated action in the long term, for frequent cleaning or regular upgrades.

So was this a huge success? Unfortunately, the Portal falls just shy, but its looks and interesting design read big in the plus column. ■ **Phil Iwaniuk**

Verdict

Features	★★★★
Performance	★★★★
Value	★★★½

Nice Aperture Science portal gun and turret looks, breezy airflow and sleek frame design.

★★★★☆

software

» APPS FOR ALL THE PLATFORMS

Windows SOFTWARE

Lightworks

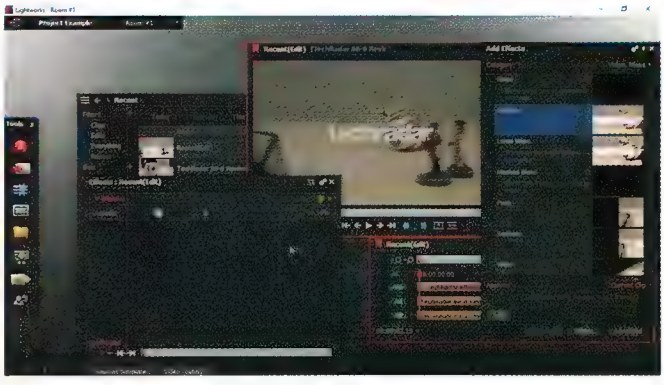
A free video-editing program that can create stunning results with its advanced tools.

FREE | WWW.LWKS.COM

Lightworks is a professional-quality video editor that's free for home use, putting an incredibly powerful toolkit within the reach of amateur and hobbyist videographers. It's fast, flexible and packed with effects and tools to help you make the most of your clips.

Whatever kind of project you have in mind, Lightworks can help you achieve it. If you simply want to trim a video to size, or combine several short sections of footage before uploading them to YouTube, Lightworks' well-designed timeline can help you get the job done in short order. Once you're done, Lightworks has preset profiles so you can export your work in the right format for your chosen video-sharing site automatically. If you're working on your own short film and need an advanced tool for post-production, it's is packed with everything you need to get your audio and visuals just right. Real-time effects and colour correction help you achieve the perfect look, and complex rendering and encoding processes take place in the background so you can continue working while they complete.

As you might expect, it'll take a while to master Lightworks' powerful toolkit. This is no mere Windows



Movie Maker substitute, and its professional roots show in its interface, which borrows terms from the world of tape-based filmmaking.

You begin by creating a project and setting a frame rate for the finished video – that'll likely be between 24fps or 60fps. You're then ready to get to work. Lightworks lets you record video directly from cameras, and import existing clips (both audio and video). Once you have all your resources, you can start adding them to your timeline to create your first cut. It looks intimidating at first, but is surprisingly intuitive once you've spent some time experimenting.

Lightworks is packed with advanced realtime effects to help you perfect your video, including colour correction, blurs and masks. There are dozens of preset effects, or you can create your own manually.

The professional edition of Lightworks was actually used to edit box-office hits including *Shutter Island*, *Pulp Fiction*, *The Departed*, *28 Days Later* and *Mission Impossible*, so it's not just for hobbyists, either. **Cat Ellis**

Calibre

An ebook reading app for anyone with an aversion to Amazon.

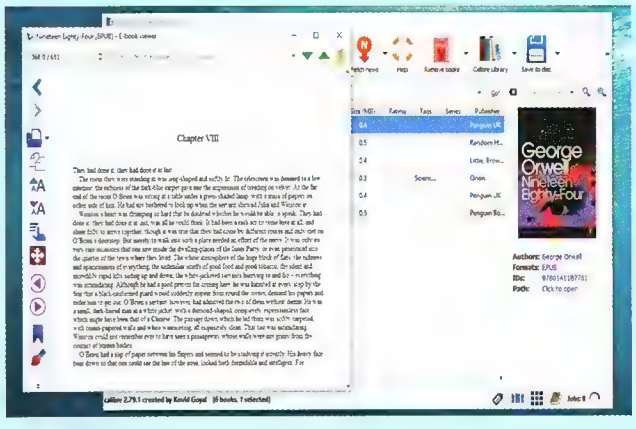
FREE | CALIBRE-EBOOK.COM

You don't need a dedicated device to enjoy ebooks. There are some excellent free apps around for reading them on your desktop, and Calibre is one of the best. It's a free, open-source ebook reader that's available for Windows, Mac and Linux, with an additional portable version available for Windows PCs. This is particularly handy, because you can keep it on a USB stick alongside your ebook collection and boot it up on any Windows system.

Calibre also supports RSS feeds, so you can gather news from your favourite magazines and news sites in one place without opening a web browser and, if you have one, you can even sync these to a dedicated e-reader.

The interface has been designed with care and attention, with bold icons that are great for touchscreens, well-labelled controls and hover-triggered pop-up explanations for anything you're not certain about.

Calibre makes it simple to transfer books between your desktop machine and any e-readers you own — in some cases, that can even be wirelessly, otherwise it's done via a USB cable.



It can also automatically convert books to the best format before transferring them to your device.

Unlike most free ebook readers (with the obvious exception of Amazon's own software), Calibre can open books in the Kindle AWZ format, although by default, it won't let you read any DRM-protected works — you can, however, get around that by using a third-party plugin. **Cat Ellis**

CloudMounter 2

Mount all your cloud storage in Finder.

$14.99 | ELTIMA.COM

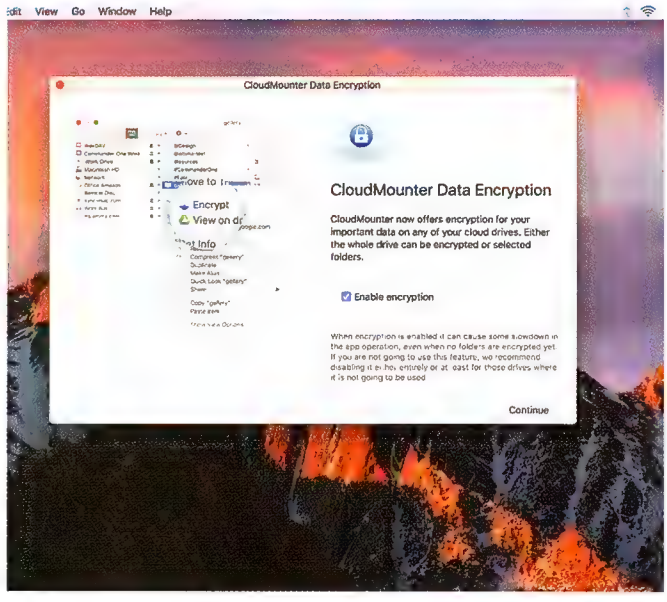
One of the greatest strengths of cloud storage services like Dropbox and Google Drive – the fact that they mirror your cloud data on your Mac – is also a big weakness.

Mirroring data and syncing it across devices makes it quick and easy to access, but also takes up valuable storage space on your Mac. CloudMounter offers to make those drives available without needing to mirror their data on your Mac, thus not taking up any extra space. It can also encrypt any cloud drive or any folder on a drive.

Once you've logged in to each cloud service, the app mounts the drive in the Finder and from there on, it's just like using a local volume, albeit a little bit slower.

The app supports Dropbox, OneDrive, Google Drive and Amazon S3, as well as FTP and WebDAV servers. We found it worked seamlessly, with the only slight difference between using, say, Dropbox in CloudMounter and Dropbox's own app being a slight delay in accessing data when using the former setup.

If you don't mind a waiting a few seconds to access your files, CloudMounter is an excellent way to save space on your Mac. **Kenny Hemphill**


Edit View Go Window Help
CloudMounter Data Encryption
CloudMounter Data Encryption
CloudMounter now offers encryption for your important data on any of your cloud drives. Either the whole drive can be encrypted or selected folders.
Enable encryption
Continue

Retrospect Backup 14

Smart, comprehensive protection.

FROM US$119 | RETROSPECT.COM

Good practice for your backups is to have several copies of your files on multiple kinds of media and at different locations. Time Machine, Carbon Copy Cloner and online storage can do this for one person, but when you have multiple Macs to care for, the task can be made easier to manage with one point of protection.

Setting up Retrospect requires installing its server on one computer, the client on those to be backed up, and then configuring what gets backed up, where to and when. Catalogues of backups are saved separately to the backups themselves.

You'll want to read the lengthy documentation to ensure you pick the best options for your needs, like what to exclude, settings for password-protected AES encryption and whether to verify backups byte by byte. Version 14's big new addition is built-in support for Backblaze's B2 service; Dropbox and Amazon are integrated, too.

If you have just five client Macs to back up, the US$119 Desktop version is enough. To back up a server as well, the cost is US$499, which also covers 20 clients. Raising the number of clients starts at an affordable US$29 for one extra Mac. **Alan Stonebridge**

Winclone 6

Back up Boot Camp with ease.

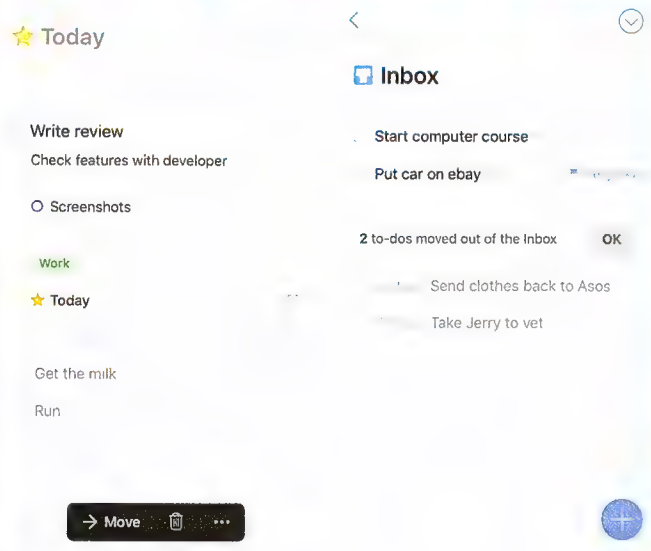
US$19.99 | TWOCANOES.COM

Apple makes it very easy to move files between old and new Macs. But if you also run Windows under Boot Camp, this app is an indispensable cloning utility that makes migration a snap. Winclone's interface is straightforward and easy to use: select the Boot Camp volume, choose 'Save Image', click start and sit back as the software sings.

In our tests, it took mere minutes to back up our basic 64GB Boot Camp partition, which can then be restored to the same volume or as a standard disk image. We had no trouble wiping our Boot Camp volume, restoring it from a Winclone image, and then booting right back into Windows 10 as if nothing had even happened.

With the more expensive Standard (US$39.99) or Pro (US$249.99) editions, you can perform other tricks, such as cloning Windows to bootable external volumes, although it's not quite as seamless and requires several extra steps. The Pro version also lets you create a self-contained installer to be distributed to other users, and gives you a year's worth of maintenance and support.

What else is new? Version 6 allows read/write mounting of Windows volumes, plus a refreshed toolbar with helpful options to summon technical support, view tutorial videos, or purchase app upgrades. **JR Bookwalter**



Things 3

Getting things done more elegantly.

$14.99 | CULTUREDCODE.COM

Things first came out in 2008, when iPhone productivity apps were a novelty and skeuomorphism was the go-to interface design philosophy. The to-do list app checked both boxes at the time, but despite occasional updates, it fell behind rivals like Wunderlist and Todoist, which brought their own innovations to the 'Getting Things Done' category.

Five years in the making, Things 3 aims to close the gap, and it's efforts are mostly successful. A minimalist interface replaces the old one, and makes to-dos a lot more adaptive and flexible, with tags, checklists, sub-headings (new), start dates and deadlines responding to a range of gestures to make organisation simpler. The new Quick Find feature enables global searches from within any to-do, while a circular progress indicator has been added to let you keep better track of your projects. The Today and Upcoming sections have been rethought, and now helpfully integrate iOS calendar events.

Perhaps the best new feature is the big blue Magic Plus button that lives in the bottom corner of the screen. Dragging it to any location instantly generates a relevant item there, such as a sub-heading in a project, or a task with a due date in your inbox.

Neat touches like this suggest ease of use has remained at the forefront of the developer's mind over version 3's long gestation –which makes the inability to use natural language input in the task entry field, and the lack of a universal app, all the more surprising. (The iPad version is also considerably more costly at $30.99.) As it is, however, Things 3 is a solid release that should re-energise your motivation for Getting Things Done.

Things 3 is generally solid, and single-player Things veterans will love the new design, but look elsewhere if you have to address collaboration needs. **Tim Hardwick**

Chuck

Too many emails? Chuck 'em!

FREE | CHUCK.EMAIL

Our significant other has an inbox that gives us the willies: where our inbox is as neat, clutter-free and well-tended as a suburban lawn, their inbox is an untamed jungle full of crazed monkeys where messages hang around for months unread, and urgent messages of great importance are lost in a tsunami of spam. It's as mixed as our metaphors, and what it really needs is a good clean-up, courtesy of Chuck.

This app's purpose in life is to gather a whole bunch of messages and chuck them out of your inbox — or inboxes — either permanently or temporarily, so that you can get on with your life. It gives you a bird's-eye view of your email, grouping messages by subject, sender or date, and it supports multiple mail accounts for those of us forced to use multiple addresses or aliases. As well as iCloud, it runs Gmail, Outlook, Yahoo!, Comcast, Office 365, AOL and Mail.com.

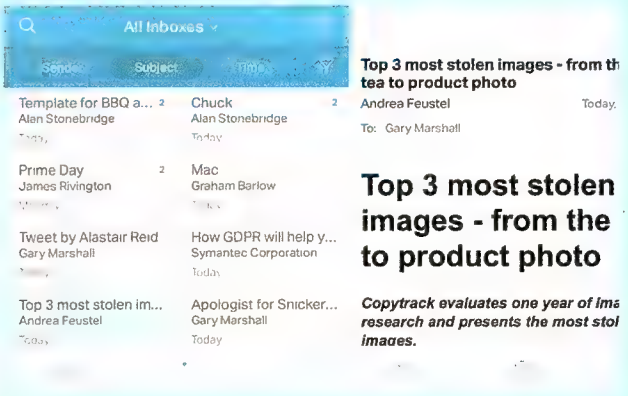
It's ridiculously quick on even the busiest email account, and its interface works really well on iPhone. There's an iPad version too, but we felt much more comfortable with Chuck on the smaller screen, where it feels just right when used one-handed. It supports landscape on Plus-size phones, too, delivering a familiar if cramped two-pane layout that enables you to see messages — although if they're formatted, only a few lines at a time.

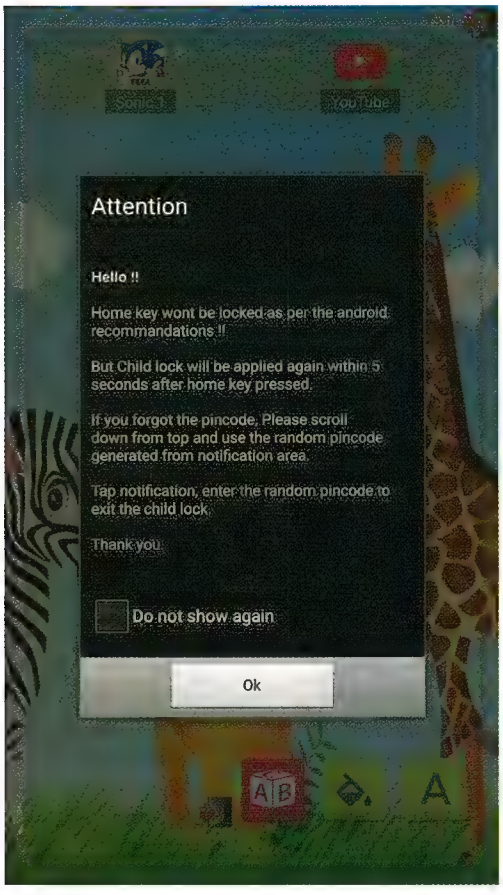
Chuck isn't the best way to read email, but it's superb at organising it. You can select huge numbers of messages at once and then move, spam, delete, star/unstar or mark them as read/unread. The app has a 'chill' option that hides messages for a specific number of days — handy if you're on vacation, for instance.

Chuck's built-in search is lightning fast, and the ability to manage multiple inboxes simultaneously makes email management effortless.

If you work in the sort of environment where butt-covering emails ping all day long, or you take part in very busy email discussions, the app will save you enormous amounts of time. It's not our favourite email app for everyday use, but when the going gets tough, it's the app we turn to to remove the dead wood.

If email feels like an avalanche, chuck all the inessential ones away, because this is a superb app for achieving inbox zero. **Gary Marshall**




Attention
Hello !!
Home key wont be locked as per the android recommandations !!
But Child lock will be applied again within 5 seconds after home key pressed.
If you forgot the pincode, Please scroll down from top and use the random pincode generated from notification area.
Tap notification, enter the random pincode to exit the child lock.
Thank you
Do not show again
Ok

Child Lock Launcher

Keeping the kids out of your stuff.

FREE | TINYURL.COM/APC445-CHILD

Maintain your privacy and keep the calls of "Mum/Dad I'm borrreeedd! Can I watch YouTube?" to a minimum with this app that limits the access your offspring have to your phone. Set up a passcode, choose the apps and games that you're happy for your child (or even total stranger) to use and play, and you're set.

Smart options also restrict system-level functions, like locking the camera key (if your phone has one), and ignoring long presses on the home button to prevent Google searches. Wi-Fi can be toggled on/off, and the volume limited. Younger kids might also like the simple painting apps that are built in, though the palette is restricted to less than a dozen colours, and there's no way to save these creations. It's rudimentary to look at, and while you can technically still access the home screen, Child Lock Launcher restarts five seconds after hitting the home key, or if anyone tries to access any apps. For the price of precisely zero dollars, it's an incredible return on investment. **Paul Taylor**

Firefox Focus

The joys of leaving no trace.

FREE | WWW.MOZILLA.ORG

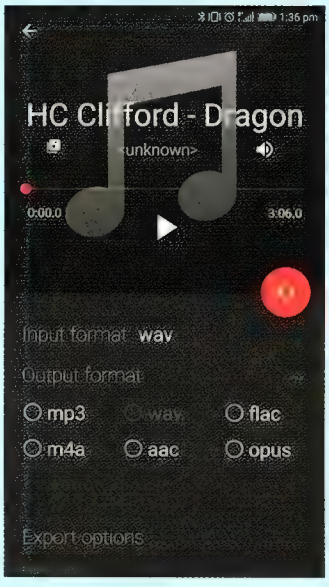
The latest offering from Mozilla is a lightweight mobile browser that promises "next-level privacy" without costing a cent. From the outset, this app's focus on privacy is obvious — you're not even allowed to take screenshots by default — and its approach is one of elegant simplicity rather than option-rich detail. You can choose whether to block ad, analytic, social and other trackers individually, and that's all you get to manage when it comes to online privacy. As for device-facing privacy, 'stealth' mode disables screenshots and makes sure you won't see a thumbnail of your current page in your recent apps list. There's also a trash icon that appears as soon as you scroll up when browsing that immediately erases your history and cache, returning you to the default search homepage. It's a very neat and pleasing browser and the defence against trackers will prove quite popular in today's internet climate, although we did find it a little sneaky that Mozilla's own (anonymous) tracker was enabled by default. **Harry Domanski**

Timbre

Media manipulation on the go.

FREE | WWW.TIMBRE-APP.COM

Timbre is a suite of simple media editing tools compiled together in a single app, allowing you to do a number of nifty things with audio and video files directly from your phone or tablet. The simplicity of this app goes a long way in making it exceptional, with a gorgeously Spartan home page and interface that never confuses. Most of what you can do to audio files you can also do to video, including cutting, joining, omitting and splitting, all of which allow you to create new files out of portions or combinations of existing files. There's also a handy tool that can convert your current song or video to a different file type, for instance from WAV to MP3 or MKV to AVI, and a separate tool that can reduce the bitrate of a song. The video section adds the ability to remove the audio from a video or take that audio and create a separate audio file from it, the latter of which is incredibly useful if you're wanting to listen to something from video footage without having to play the video itself. **Harry Domanski**



Ring

Why don't you give me a call?

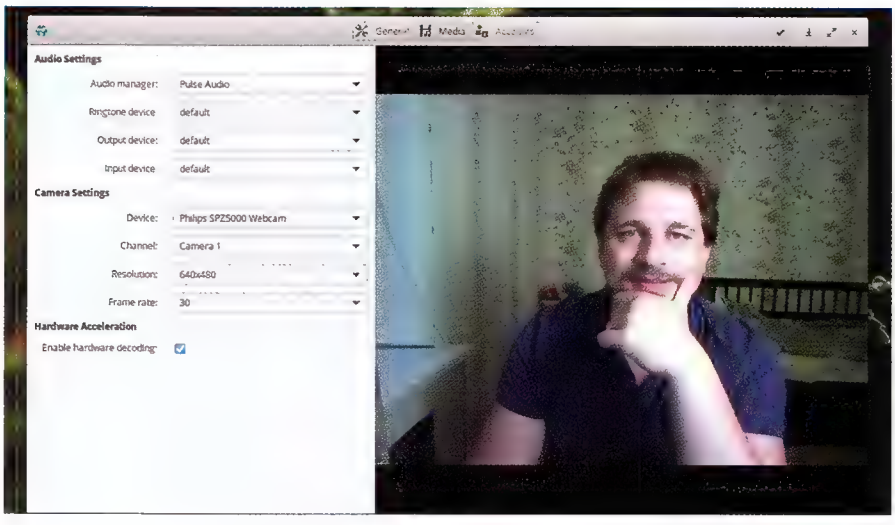
FREE | OTTER-BROWSER.ORG

Microsoft recently ended the support of the native Qt-based Skype client on Linux and forced everyone to upgrade to the newer, yet very limited and resource-hungry Electron-based Skype. This is essentially a reskinned and slightly tweaked version of the web version of Skype.

This will lead to a demand for alternative and possibly open-source communication software, which can handle secure messaging and make video calls. We believe that Ring could be a decent substitute, and here's why.

GNU Ring is a voice-over IP software that's both user-friendly and professional in nature. It supports audio/video communications with call transfers, holding and automatic adjusting of audio quality... just like the classic version of Skype did in the pre-Microsoft days. Ring supports decentralised (peer-to-peer) calls, but it also adds Asterisk supports thanks to the ability to use SIP accounts.

The software consists of two main parts: the daemon and the client.



While the daemon does all the logic in the background, the client is actually a GUI that you interact with. There are many clients for Ring, but it would be enough to mention the Plasma-friendly one at **github.com/KDE/ring-kde** and a set of clients supported directly by Savoir-faire Linux, a company behind the Ring technology. These are the official GTK3-based Ring Gnome and the Ring for Android (find it at Google Play).

When you launch a client (whatever it is) for the first time, it asks you to create an account, which is when you choose a nickname and set a password. Once you're done, you can start messaging with anyone whose nickname you know.

The easiest way to test-drive Ring is to create one account on your Linux machine and another on your smartphone and have a chat with yourself. If you want to set up your own Ring server, have a look at **github.com/weavejester/ring-server**. This will enable you to build a walled garden for secure communications, without relying on Ring's public server.

Alexander Tolstoy

GSmartcontrol

Run tests on a specific drive with this disk diagnostics tool.

FREE | BIT.LY/2TZBJWU

For years, all hard drives and SSDs have supported SMART (self-monitoring, analysis and reporting technology), which alerts you to a dying hard drive before it's too late to transfer your data.

Linux has always supported SMART, but there's often been uncertainty in how you'd receive such alerts when the drive was about to fail. Previously, you could use commands such as `smartctl` or `smartd` from the Smartmontools package, or you can go with the gorgeous Gnome Disks application, which offers a snazzy GUI for Smartctl.

However, if you don't use Gnome but still want to access Smartctl via an interface, consider GSmartcontrol. This is a standalone application that's been recently ported to GTK3 and is available for Linux, Windows and Mac OS.

GSmartcontrol is perfect for non tech-savvy users who know enough computing basics to want their disk drives to remain in good shape. The application displays the icons of all the physical drives in your system, much like in a file manager. You can quickly find out the exact model number of each device and see if it's passed the basic health check. Simply double-click an icon to open a window containing all the details that Smartctl usually prints in the Terminal.

GSmartcontrol divides everything into six tabs and enables you to explore what features your drive has, view error logs, display the drive's lifetime in hours and more. One of the tab enables you to manually run some tests on a specific drive. You can choose either a short, extended or conveyance self-test and see if your drive's really matches up to what the program is saying.

We loved GSmartcontrol for its usefulness and compact size that enables you to use it on a custom minimalistic desktop, without pulling many undesired dependencies. The developer provides many packages for all major Linux distros, so for most readers installing GSmartcontrol is just a few mouse clicks away.

Alexander Tolstoy

Intel strikes back

Intel's new X-Series CPUs and X299 motherboards aim to take on AMD's Ryzen, but does the platform have what it takes? Josh Collins investigates.

For PC enthusiasts that keep their finger on the tech news pulse, the release of Intel's new high-end desktop (HEDT) X299 chipset and associated CPUs to replace X99 and Broadwell-E-based processors was expected. What wasn't expected was Intel's seemingly knee-jerk reaction to AMD's forthcoming Ryzen Threadripper 1950X (16C/32T) processor and X399 chipset, headed by a chunky 18-core, 32-thread processing behemoth known as the Intel Core i9-7980XE. Furthermore, the introduction of two micro-architectures on the new Intel X299 platform, in the form of Skylake-X and Kaby Lake-X, puzzled some enthusiasts and annoyed others.

AMD'S KEEPING SOME POWDER DRY

Like the Ryzen 5 and 7 range before it, AMD's imminent Ryzen Threadripper processors are set to disrupt the market and Intel seemingly wants nothing of it, driven by a quest for continued supremacy. To ward off the inevitable AMD push, Intel appears, at first glance, to have stepped up to the crease, launching a new top tier processor brand, Core i9, led by the aforementioned Core i9-7980XE. But like most new product releases, the devil is most certainly in the details.

The new Intel X299 platform has compute capabilities facilitated by two processor families. The first option, codenamed Kaby Lake-X, is an adaptation of the mainstream desktop Kaby Lake-S SKU found on the mainstream Z270, H270 and B250 chipset platforms, with notable comparison with the Kaby Lake-S-based Core i5-7600K and Core i7-7700K. These K SKUs are available in a revised package and spec as the Kaby Lake-X based Core i5-7640X and Core i7-7740X. The second option, codenamed Skylake-X, is what enthusiasts would have expected to be the Skylake-E offering, continuing the progression of Haswell-E and Broadwell-E from the X99 platform. The Skylake-X range starts with the Core i7-7800X and topped by the Core i9-7980XE. We'll cover the details of the Kaby Lake-X options in the following pages.

TOP (END) SECRETS

The first detail to note regarding the Skylake-X-based range is the scarce information available from Intel for the upper echelons of the new processor series. The second detail to note is the significant differences in specs ranging from the i7-7800X through to the top i9-7980XE. At the time of writing, only the Core i7-7800X, i7-7820X and i9-7900X have been launched, with the i9-7900X commanding a $1,449 price tag. The i9-7920X, i9-7940X, i9-7960X and i9-7980XE models have been paper-launched, though product specs are yet to be fully fleshed out and market availability and pricing detailed. However, Intel has made it known the Core i9-7920X will become available

HIGH-END DESKTOP INTEL PROCESSORS — SPECS COMPARISON

PRODUCT FAMILY NAME	INTEL CORE 7TH GEN.		INTEL CORE X-SERIES PROCESSORS		
MODEL NAME	CORE i5-7600K	CORE i7-7700K	CORE i5-7640X	CORE i7-7740X	CORE i7-7800X
MICRO-ARCHITECTURE	KABY LAKE-S	KABY LAKE-S	KABY LAKE-X	KABY LAKE-X	SKYLAKE-X
SOCKET	LGA 1151	LGA 1151	LGA 2066	LGA 2066	LGA 2066
SUPPORTING CHIPSET	Z270/H270/B250	Z270/H270/B2550	X299	X299	X299
STATUS	LAUNCHED	LAUNCHED	LAUNCHED	LAUNCHED	LAUNCHED
LAUNCH DATE	Q1 2017	Q1 2017	Q2 2017	Q2 2017	Q2 2017
LITHOGRAPHY	14NM	14NM	14NM	14NM	14NM
USD RELEASE PRICE	$243	$350	$243	$350	$389
MARKET PRICE (AUD)	$335	$479	$359	$499	$559
NO. OF CORES	4	4	4	4	6
NO. OF THREADS	4	8	4	8	12
PROCESSOR BASE FREQUENCY	3.8 GHZ	4.2 GHZ	4.0 GHZ	4.3 GHZ	3.5 GHZ
MAX. TURBO FREQUENCY	4.2 GHZ	4.5 GHZ	4.2 GHZ	4.5 GHZ	4.0 GHZ
INTEL TURBO BOOST TECHNOLOGY 2.0	YES	YES	YES	YES	YES
INTEL TURBO BOOST MAX TECHNOLOGY 3.0	NO	NO	NO	NO	NO
CACHE SIZE (L3)	6MB	8MB	6MB	8MB	8.25MB (6 x 1.375MB)
CPU NATIVE PCIE3.0 LANES	16	16	16	16	28
TDP	91W	91W	112W	112W	140W
MEMORY TYPE	DDR4	DDR4	DDR4	DDR4	DDR4
MAX. MEMORY DENSITY	64GB	64GB	64GB	64GB	128GB
MAX. JEDEC MEMORY FREQUENCY	DDR4-2400	DDR4-2400	DDR4-2666	DDR4-2666	DDR4-2400
MEMORY CHANNELS	DUAL CHANNEL	DUAL CHANNEL	DUAL CHANNEL	DUAL CHANNEL	QUAD CHANNEL
BUNDLED COOLER	NO COOLER	NO COOLER	NO COOLER	NO COOLER	NO COOLER

in August and the i9-7980XE by October. It's not exactly a clear-cut product launch, so best to check availability with your preferred reseller.

Collectively, the Kaby Lake-X and Skylake-X offerings form the Intel X-series processor range and are marketed as a scalable solution from four cores through to 18 cores, with the Core i9 range pitched for "mega-tasking". The scalable claim is relevant, but it doesn't mean enthusiasts will appreciate the scaling and shortcomings of some of the offerings. For example, Kaby Lake-X is restricted to dual-channel memory and, therefore, half of the memory channels on the motherboard are non-functioning.

IS THIS REALLY A HIGH-END PLATFORM?

The most difficult caveat to swallow is the lack of CPU based PCIe lane allocation for the Kaby Lake-X options (16 PCIe lanes) and neutered 28 lanes on the Skylake-X-based Core i7 models. To put this into perspective, the X99-based 6C/12T Core i7-6850K delivers 40 PCIe lanes from the CPU at $650, while the 6C/12T i7-6800K delivers 28 lanes at $550. Whereas, the 10C/20T i9-7900X is the first CPU in the product stack with >28 lanes, delivering 44 lanes at a price exceeding $1,400, while the $860 8C/16T i7-7820X only has 28 lanes – what the hell, Intel?!

For most enthusiasts, the increase in the stock RAM frequency speed from DDR4-2400 to DDR4-2666 is a moot point, as they're already going to be using overclocked RAM solutions. Nonetheless, it's a spec upgrade that puts the platform in line with AMD's Ryzen 7 options.

For workstation users looking to maximise the functional stability of the platform, retaining stock specs, the speed bump is welcomed. The stated DDR4-2666 solution is for one DIMM per channel (1DPC) configurations, with the frequency dropping to DDR4-2400 when running two DIMMs per channel – the previous X99 platform with Broadwell-E CPU drops to DDR4-2133 when running 2DPC.

Further incremental gains moving from X99 to X299 have been achieved on the platform connectivity front. The biggest point of interest is the upgrade to the Direct Media Interface bus, which connects the CPU to the PCH (ie, Skylake-X/Kaby Lake-X to X299 and major platform I/O, such as storage and expansion slots). Moving from X99 with a DMI2.0 bus utilising 4 x PCIe2.0 lanes to X299 featuring DMI3.0 with 4 x PCIe3.0 lanes has doubled bandwidth between the CPU and PCH. This is a welcomed update for HEDT platform users with complex storage arrays that could otherwise be choked by the limited DMI2.0 bus bandwidth.

Intel Turbo Boost Max Technology 3.0 is applied to the Core i7-7820X and higher SKUs. This combined hardware-software solution identifies the two fastest cores on the processor die to provide improved single-threaded performance on X-series processors. The driver, linked with the hardware-based feature, allows end users to direct workloads to the fastest core by setting priority to preferred applications. This allows for increased IPC performance on single and dual-threaded processes via the higher operating frequency.

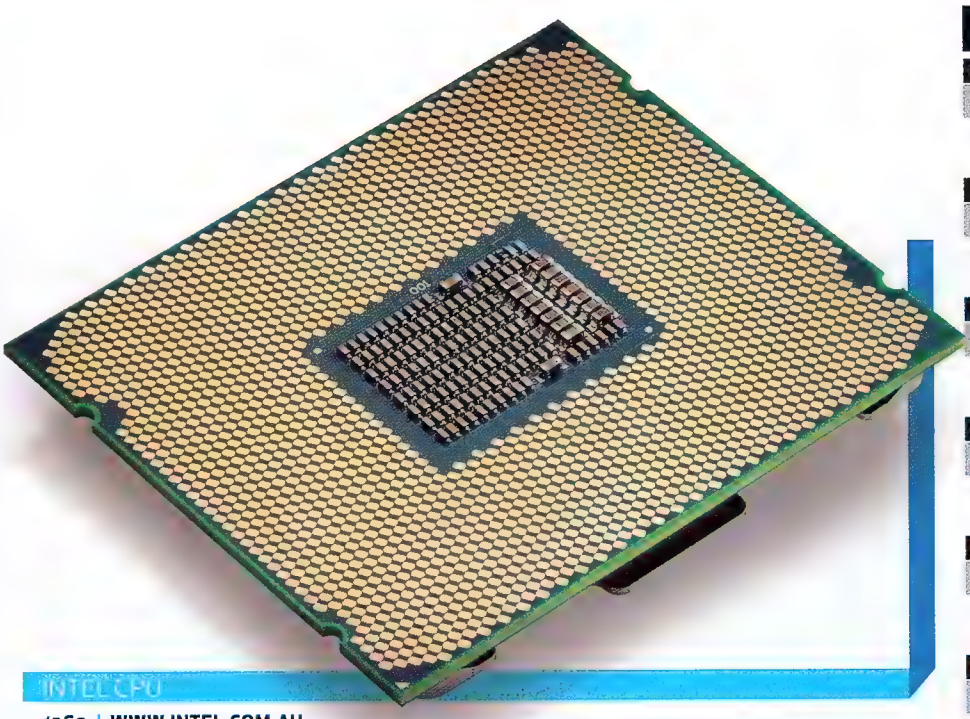
SOMETHING FOR EVERY NICHE?

The hardest pill for enthusiasts to swallow with the new X299 platform and associated CPU SKUs is the sheer level of product segmentation applied, seemingly with the goal of bumping users up the product stack (emptying their wallets in the process) compared with previous fifth- and sixth-gen CPU solutions on the X99 platform. Whether it be the peculiar neutering of RAM performance and Boost 3.0 support on the Core i7-7800X, the 28 CPU-based PCIe lanes on the i7-7820X, the loss of resources and features when using Kaby Lake-X, or the sheer price for any Core i9 high core and thread count CPU, it's hard to feel like the choices are in the enthusiast's favour.

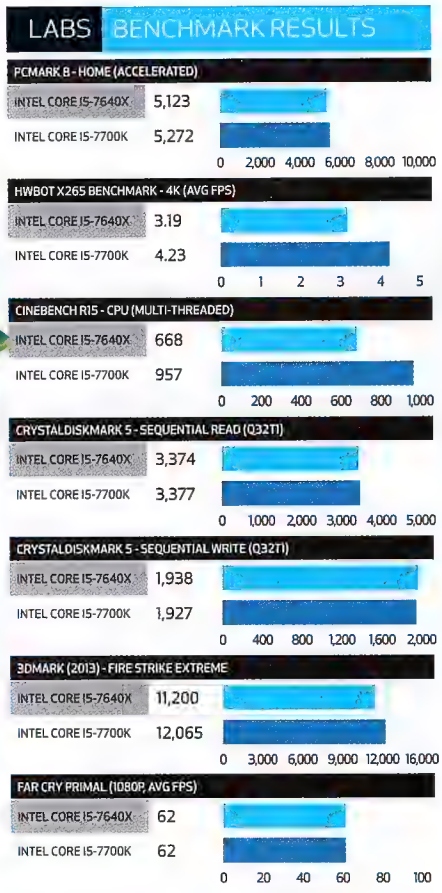
One thing's for sure – all eyes are now firmly on AMD's Ryzen Threadripper. ■

> "For most enthusiasts, the increase in the stock RAM frequency speed from DDR4-2400 to DDR4-2666 is a moot point, as they're already going to be using overclocked RAM solutions."

CORE i7-7820X	CORE i9-7900X	CORE i9-7920X	CORE i9-7940X	CORE i9-7960X	CORE i9-7980XE
SKYLAKE-X	SKYLAKE-X	SKYLAKE-X	SKYLAKE-X	SKYLAKE-X	SKYLAKE-X
LGA 2066	LGA 2066	LGA 2066	LGA 2066	LGA 2066	LGA 2066
X299	X299	X299	X299	X299	X299
LAUNCHED	LAUNCHED	UNRELEASED	UNRELEASED	UNRELEASED	UNRELEASED
Q2 2017	Q2 2017	Q3 2017	Q4 2017	Q4 2017	Q4 2017
14NM	14NM	14NM	14NM	14NM	14NM
$599	$999	TBC	TBC	TBC	TBC
$859	N/A	N/A	N/A	N/A	N/A
8	10	12	14	16	18
16	20	24	28	32	36
3.6 GHZ	3.3 GHZ	TBC	TBC	TBC	TBC
4.3 GHZ	4.3 GHZ	TBC	TBC	TBC	TBC
YES	YES	YES	YES	YES	YES
YES	YES	YES	YES	YES	YES
11MB (8 x 1.375MB)	13.75MB (10 x 1.375MB)	16.5MB (12 x 1.375MB)	19.25MB (14 x 1.375MB)	22MB (16 x 1.375MB)	24.75MB (18 x 1.375MB)
28	44	44	44	44	44
140W	140W	140W	TBC	TBC	TBC
DDR4	DDR4	DDR4	DDR4	DDR4	DDR4
128GB	128GB	128GB	128GB	128GB	128GB
DDR4-2666	DDR4-2666	DDR4-2666	DDR4-2666	DDR4-2666	DDR4-2666
QUAD CHANNEL	QUAD CHANNEL	QUAD CHANNEL	QUAD CHANNEL	QUAD CHANNEL	QUAD CHANNEL
NO COOLER	NO COOLER	NO COOLER	NO COOLER	NO COOLER	NO COOLER



$360 | WWW.INTEL.COM.AU


LABS BENCHMARK RESULTS
PCMARK 8 - HOME (ACCELERATED)
INTEL CORE I5-7640X 5,123
INTEL CORE I5-7700K 5,272
0 2,000 4,000 6,000 8,000 10,000
HWBOT X265 BENCHMARK - 4K (AVG FPS)
INTEL CORE I5-7640X 3.19
INTEL CORE I5-7700K 4.23
0 1 2 3 4 5
CINEBENCH R15 - CPU (MULTI-THREADED)
INTEL CORE I5-7640X 668
INTEL CORE I5-7700K 957
0 200 400 600 800 1,000
CRYSTALDISKMARK 5 - SEQUENTIAL READ (Q32T1)
INTEL CORE I5-7640X 3,374
INTEL CORE I5-7700K 3,377
0 1,000 2,000 3,000 4,000 5,000
CRYSTALDISKMARK 5 - SEQUENTIAL WRITE (Q32T1)
INTEL CORE I5-7640X 1,938
INTEL CORE I5-7700K 1,927
0 400 800 1,200 1,600 2,000
3DMARK (2013) - FIRE STRIKE EXTREME
INTEL CORE I5-7640X 11,200
INTEL CORE I5-7700K 12,065
0 3,000 6,000 9,000 12,000 16,000
FAR CRY PRIMAL (1080P, AVG FPS)
INTEL CORE I5-7640X 62
INTEL CORE I5-7700K 62
0 20 40 60 80 100

Intel Core i5-7640X

Does the baby of Intel's new X-series CPU range make sense?

For many, the Core i5-7640X is a chip to be toyed with out of curiosity but isn't really a purchasing choice made for an optimised solution.

It's common for PC enthusiasts to own multiple graphics cards during the lifecycle of a custom DIY desktop PC, especially when the central usage focus is gaming. Essentially, a system spec is built as a 'set and forget' solution, with the GPU and perhaps storage being revisited as an interim upgrade. This is where Intel's marketing of the X299 platform as a scalable solution, while a valid point technically, becomes a soft notion in reality. The reason being, upgrading from the Core i5-7640X to even the entry-level Core i9, the i9-7900X, demonstrates a price differential of about $1,000. Frankly, someone looking to spec a $360 CPU is unlikely to consider the CPU upgrade path unless there are extenuating circumstances preceding the purchase of a Core i5-7640X over, for example, the $560 Core i7-7800X.

Additionally, due to the comparatively small direct-to-CPU PCIe lane allocation of 16 lanes and support for only dual channel RAM, many of the features of a X299 motherboard simply go unused.

The move from X99 to X299 has delivered more PCIe bandwidth from the PCH, with X299 sporting 24 x PCIe 3.0 lanes opposed to X99's eight PCIe 2.0 lanes. This is a welcomed update for the HEDT platform overall; however, there's still a resource allocation draught for direct-to-CPU PCIe paths when using Kaby Lake-X CPUs.

Beyond the obvious move from the Kaby Lake-S LGA 1151 socket to Kaby Lake-X LGA 2066 socket, the repackaged Kaby Lake-derived solutions feature increased base clock frequencies. The Core i5-7640X has received a 200MHz bump, upping the base frequency from 3.8GHz to 4.0GHz, while retaining the same 4.2GHz boost clock frequency.

By moving Kaby Lake micro-architecture to the X299 platform from Z270/H270/B250, the stock RAM frequency is bumped from DDR4-2400 to DDR4-2666. The stock RAM frequency increase is nice, though the majority of i5-7600K and i7-7700K users already run overclocked DDR4-2800+ RAM frequencies on the Kaby Lake-S parts when paired with a Z270 mobo. Paired with the fact X299 is a fully unlocked platform, meaning there are no stock RAM limitations like on H270 or B250, the increased stock RAM frequency is largely a redundant feature update for Kaby Lake-X over Kaby Lake-S.

Processor TDP is also increased, from 91W to 112W, though this is essentially a result of increased overclocking capability as facilitated by the increased power delivery afforded by the move from LGA 1151 to LGA 2066 and the X299 boards having strong motherboard VRM for high core-count CPUs. This has made the Kaby Lake-X solutions popular with overclockers, as the units compete directly with the Kaby Lake-S parts. By moving Kaby Lake to X299, the CPUs have been returning 24/7 overclocks 100–400MHz higher than what's possible on the Kaby Lake-S parts.

If you love to overclock, this solution makes plenty of sense. For everyone else, think long and hard about your usage case alongside system needs and wants before making a purchase.

Josh Collins

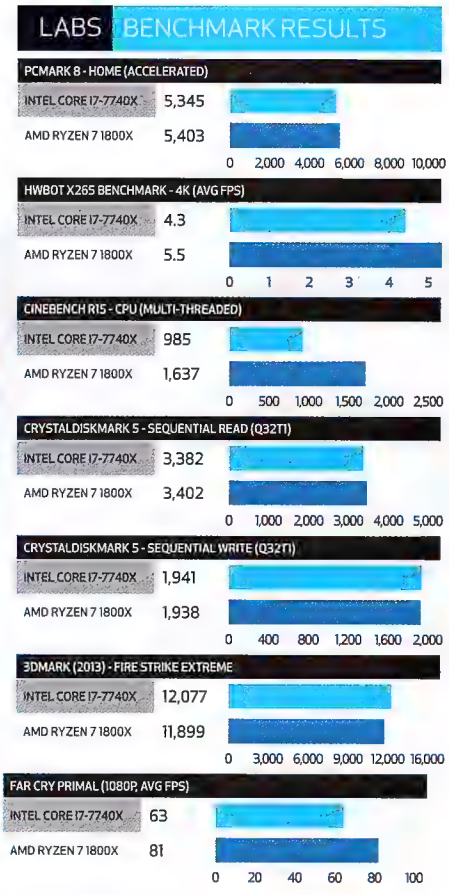
Verdict

Features	★★★
Performance	★★★★
Value	★★★

A capable CPU in its own right, but when compared to the rest of the market, it's mostly just an expensive enthusiast toy.

★★★

$500 | WWW.INTEL.COM.AU


LABS BENCHMARK RESULTS
PCMARK 8 - HOME (ACCELERATED)
INTEL CORE I7-7740X 5,345
AMD RYZEN 7 1800X 5,403
0 2,000 4,000 6,000 8,000 10,000
HWBOT X265 BENCHMARK - 4K (AVG FPS)
INTEL CORE I7-7740X 4.3
AMD RYZEN 7 1800X 5.5
0 1 2 3 4 5
CINEBENCH R15 - CPU (MULTI-THREADED)
INTEL CORE I7-7740X 985
AMD RYZEN 7 1800X 1,637
0 500 1,000 1,500 2,000 2,500
CRYSTALDISKMARK 5 - SEQUENTIAL READ (Q32T1)
INTEL CORE I7-7740X 3,382
AMD RYZEN 7 1800X 3,402
0 1,000 2,000 3,000 4,000 5,000
CRYSTALDISKMARK 5 - SEQUENTIAL WRITE (Q32T1)
INTEL CORE I7-7740X 1,941
AMD RYZEN 7 1800X 1,938
0 400 800 1,200 1,600 2,000
3DMARK (2013) - FIRE STRIKE EXTREME
INTEL CORE I7-7740X 12,077
AMD RYZEN 7 1800X 11,899
0 3,000 6,000 9,000 12,000 16,000
FAR CRY PRIMAL (1080P, AVG FPS)
INTEL CORE I7-7740X 63
AMD RYZEN 7 1800X 81
0 20 40 60 80 100

Intel Core i7-7740X

It's a lot cheaper than its Core i9 sibling, but can this X-series Core i7 stand up to its regular counterpart?

Like its Kaby Lake-X stablemate, the Core i7-7740X has a tough task to justify its existence. For the hardcore overclockers, it unleashes further potential from the Kaby Lake silicon, previously withheld by the LGA 1151 socket and associated Z270 boards that the Kaby Lake-S Core i7-7700K calls home.

Also like the i5-7640X, the i7-7740X receives a slight base frequency increase, moving from 4.2GHz to 4.3GHz, while retaining the same 4.5GHz boost frequency as its Core i7-7700K brethren. Paired with an increase of stock RAM frequency from DDR4-2400 to DDR4-2666 in a one DIMM per channel configuration, the i7-7740X looks like an attractive option. However, this view becomes muddied, as when paired with effective cooling, the CPUs spend the majority of processing load time operating at the boost frequency. Furthermore, whether on X299 with Kaby Lake-X or Z270 with Kaby Lake-S (K SKU), most users will be running overclocked RAM frequencies, exceeding the stock spec. Basically, the stock RAM speed bump is a redundant addition.

Overclocking is the call to purpose for the i7-7740X. Like the i5-7640X, it makes the most of the supporting motherboard power delivery hardware, namely the socket and VRM, to provide a significantly higher performance ceiling when overclocking. During testing for the i7-7700K and Z270 launch feature in *APC* 437, our i7-7700K sample established a functional, consistent overclock of 4.7GHz, topping out at 4.8GHz but crashing in some tests due to the summer heat. By comparison, testing the i7-7740X and X299 delivered a functional, consistent overclock of 5.1GHz and topping out at 5.2GHz with some heat-related crashes and scraping into the operating system at 5.4GHz at 1.40v before the dreaded blue screen of death hit. We found 5.0GHz to be the sweet-spot.

Another key difference for the Kaby Lake-X offerings over the S models is the removal of the integrated graphics processing unit for the X chips. This is a moot point for most, given the association of Core i7 CPU use with discrete GPUs (like the Nvidia GeForce GTX 1080 Ti we used in testing) and simply a fact of the Intel X platform not supporting iGPU implementations.

We welcome the improved overclocking capability, yet we view the i7-7740X implementation as a glass half full scenario. The reasoning behind this is linked to the low PCIe lane count for direct-to-CPU communications. Even with the 24 PCIe 3.0 lanes from the X299 PCH, the fact the i7-7740X only sports 16 direct-to-CPU PCIe lanes makes for tricky config and spec planning to ensure all planned resource implementation can be supported by the platform. If considering a Kaby Lake-X purchase, we strongly advise pre-planning resource allocation and thoroughly reviewing the motherboard manual for lane allocation, lest you be disappointed upon realising shared resources.

Overall, it's a fun platform from a toy perspective, but lacking fiscal viability compared with an equivalent i7-7700K/Z270 solution and resource viability from a HEDT solution angle. ■ **Josh Collins**

Verdict

Features ★★★½☆
Performance ★★★★☆
Value ★★½☆☆

A solid solution for keen overclockers, but expensive and under resourced for the average consumer or HEDT buyer.

★★★☆☆

apc RECOMMENDS

$499 | WWW.ASROCK.COM

ASRock X299 Taichi

A networking-focused option, with a surprise or two.

Vying with the ASUS Prime X299-Deluxe for the attention of the networking-focused HEDT buyer, the Taichi provides a strong current-gen networking front facilitated by three Intel NICs. Gigabit Ethernet is delivered by the Intel I219V and I211-AT, paired with the Intel dual-band wireless-AC 3168 for 802.11ac support.

Storage connectivity is a strong point for the Taichi. Going beyond the standard eight SATA 6Gbps ports delivered via the X299 PCH, ASRock has implemented an ASMedia ASM1061 controller to provide two additional SATA3 ports to achieve the total 10 SATA3 ports. M.2 support is also broad with three interfaces, two supporting up to the 2280 form factor and one supporting the larger 22110 form factor. These M.2 connections support both SATA 6Gbps and PCIe x4 protocols. Be mindful when implementing SATA-based M.2 SSDs, as a correlating SATA port is disabled, meaning a total of 10 SATA SSDs can be connected, regardless of whether this connectivity is via the SATA or M.2 ports.

The Taichi was a pleasant motherboard to use with no significant issues during setup and testing. However, the overall performance metrics were, for the most part, unremarkable, resulting in no podium places in the ranked results. This said, it was the only unit to reach the 3,300–3,400MB/s sequential (Q32T1) read bandwidth range while competitors only reached 2,940–2,970MB/s with the 7900X installed, while delivering the full 3,300–3,400MB/s with a Kaby Lake-X chip.

Verdict

If storage and network connectivity is your focus, consider this offering.

★★★½

$789 | WWW.ASUS.COM/AU

ASUS Prime X299-Deluxe

Refined and forward-looking.

Let's get one thing clear from the get-go – the ASUS Prime X299-Deluxe is an expensive board. Sitting towards the top of the price scale, it justifies its positioning through implementing a broad set of unique and industry standard features.

Perhaps the most notable inclusion that separates this 'board from the rest is the presence of an 802.11ad WiGig-spec WLAN card powered by Qualcomm's Atheros QCA9008-TBD1 chip, with backwards compatibility for 802.11ac and 802.11n. The usage case for 802.11ad is still being refined within the market as products begin to implement the standard. For those buyers looking to invest in a platform with the intention of a long system lifecycle, this could be an attractive offering if you foresee short-throw 4.6Gbps wireless in your computing and connectivity future. Paired with dual Gigabit Ethernet, this motherboard is bound to interest networking enthusiasts.

Performance-wise, the X299-Deluxe was middle of the pack overall, with notable first-place positions in the *Far Cry* maximum FPS and total frames rendered results. We believe conservative stock platform boost tuning was the reason behind this motherboard not securing additional performance victories. Certainly, the BIOS was refined and ready for additional user input to eke out further performance.

Sporting clean aesthetics with a sharp, angular styling across heatsinks and I/O covers, alongside honed RGB implementation, it makes for a visually pleasant offering, too.

Verdict

Refined functionality, forward-looking specs and broad connectivity.

★★★★½

$589 | WWW.ASUS.COM/AU

ASUS RoG Strix X299-E Gaming

Aesthetics on point.

ASUS continues to refine the Strix motherboard range, while in the process also making it feel more at home among the RoG stable, which it joined with the Intel Z270 and AMD X370 launches earlier this year.

Like its stablemate, the Prime X299-Deluxe (left), the Strix X299-E Gaming features NVMe SSD cooling aided by a heatsink solution integrated into the PCH, which both looks good and performs well.

General connectivity is broad and flexible. Featuring 2T2R dual-band 802.11ac Wi-Fi that's delivered by a Realtek RTL8822BE, eight SATA3 ports via the X299 PCH, dual M.2 support (with one drive standing vertically when installed), multi-GPU support when paired with a suitable CPU and a range of USB connections, including an internal USB 3.1 front-panel connector. Rounding out the hook-ups are two RGB lighting headers controlled via the ASUS Aura software, with an 80cm extension cable bundled with the board to assist placement of LED strips for even system lighting.

In the performance stakes, the Strix delivered mid-pack results, though with some further tuning, the motherboard can deliver improved performance. With a handful of podiums secured among the ranks, the Strix X299-E Gaming was unlucky to be edged out of third place by just a single point by the Aorus X299 Gaming 9 (over the page).

Overall, a fair effort from this Strix 'board, helped push it to the middle of the pack in a what's a competitive albeit topsy-turvy category.

Verdict

Pleasant aesthetics, fair performance and reasonable pricing.

★★★½☆

apc RECOMMENDS

$739 | WWW.GIGABYTE.COM.AU

Gigabyte Aorus X299 Gaming 7

High-end without the platinum coating.

There are many specs similarities between the Aorus X299 Gaming 7 and its range-topping sibling, the Gaming 9. From a networking perspective, they run the same trio of NICs; one Intel I219V, one Killer E2500 and a Killer Wireless-AC 1535 for the 802.11ac WLAN support. Rear panel I/O is the same, though the Gaming 9 sports an RGB illuminated I/O shield with an acrylic plate to diffuse the lighting.

The Aorus X299 Gaming 7 has a capable audio solution centred around the Realtek ALC1220 codec and ESS Sabre ES9018K2M DAC. While not as well equipped as the Gaming 9, the audio solution still presents well aurally and will be sufficient for most users.

Looking at performance outcomes, the Gaming 7 was, for the most part, a mid-pack contender. However, the 'board slipped to the rear in two of the Cinebench tests and the 3DMark graphics test. Further performance was easy to extract from the platform via BIOS tuning, so any performance concerns could be put to rest. On that front, the BIOS presented well, functioned appropriately without hassle and was a pleasure to use.

Placing the Gaming 7 and 9 side by side also illustrates their visual similarities, bringing forth a unified Aorus visual language.

The Aorus X299 Gaming 7 is a capable and user-friendly motherboard that provides a better value proposition than the Gaming 9 and is a quality product. However, even with a more impressive feature set than competitors, potential buyers may be swayed by other options in this roundup.

Verdict

A well featured high-end solution with strong aesthetic appeal.

★★★★☆

$859 | WWW.GIGABYTE.COM.AU

Gigabyte Aorus X299 Gaming 9

Features galore yet difficult to justify.

Splashed with high-end specifications and cloaked in stealthy yet impressive aesthetics, the Gaming 9 demonstrates Gigabyte know its way to creating a premium high-end motherboard product.

This was the first X299 motherboard to arrive in the lab for the roundup testing and, as such, saw extensive use and exploration with the Core i9-7900X used across all 'boards, but also kicked around with the i5-7640X and i7-7740X. Regardless of i5, i7 or i9 implementation, the Gaming 9 was easy to configure, exploring the boundaries and capabilities of the new platform. This resulted in almost effortless overclocking on all three chips with the benchmark suite completed with the i9-7900X at 4.5GHz and 5GHz runs with the Core i7-7740X and Core i5-7640X.

In the echo chamber of pure CPU testing, it delivered a supreme user experience. However, looking outside of this and comparing across the roundup, the Gaming 9 began to lose its lustre, due to the impressive results from significantly cheaper options. Granted, the user experience wasn't as premium, but if performance is your focus, there's now an argument against the Gaming 9.

A significant difference to the Gaming 7 is the implementation of the ESS Sabre 9018K2M DAC and TI Burr Brown OPA1622 op-amp complimenting the Realtek ALC1220 codec for a fuller and punchier sound stage.

If you have the cash to splash, the Gaming 9 is a nice premium solution, but you could save money looking elsewhere.

Verdict

Great motherboard stacked with features but stock performance leaves one wanting more.

$639 | AU.MSI.COM

MSI X299 Gaming M7 ACK

Lots of speed, but with a potential side of shenanigans.

The MSI offerings have been the surprise competitors in this roundup, with leading performance metrics in our labs testing. However, we suspect this may be due to BIOS-level tweaking increasing the all-core performance of the Core i9-7900X test sample. This behaviour is indicative of the performance gaps between the MSI offerings and competitors in tests such as the Cinebench R115 multi-threaded test and 3DMark physics.

It has been a long time since we've seen such a broad performance differentiation across a roundup of 'boards all utilising the same chipset and hardware. Sadly, due to several constraints, we were unable to get clarity on this subject before going to print. However, it wasn't the only set of results that drew a second look along with re-testing – for instance, the outlying NVMe sequential (Q31T1) read bandwidth demonstrated by the ASRock X299 Taichi versus all other competitors.

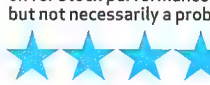
Sporting a monochrome aesthetic with metallic highlights, the M7 ACK does well to allow the integrated RGB illumination to compliment the overall industrial design.

The dual M.2 ports receive a heatsink cover extending from the PCH heatsink with two pronged heatsinks to wick heat away from hammered NVMe SSDs. From a practical perspective the solution requires the removal of any GPUs to access the M.2 ports.

The BIOS didn't have the same level of refinement as we experienced with the ASUS and Gigabyte boards, but it was clearly enough to pump out the results.

Verdict

Some BIOS funny business going on for stock performance results, but not necessarily a problem.



apc HOT PRODUCT

$449 | AU.MSI.COM

MSI X299 SLI Plus

Lower-priced, but thankfully not low on performance.

The SLI Plus brought with it an unusual conclusion to this roundup – the cheapest 'board won the performance stakes. That's particularly unusual for an Intel high-end desktop roundup. And you know it's an Intel HEDT motherboard roundup when the cheapest offering is still nearly $500! But there's more than meets the eye here.

As mentioned in the M7 ACK review (left), we believe there's some all-core performance boosts taking place that is coded into the BIOS stock parameters. This practice was rampant a couple years ago and was thought to have been stamped out. As reviewers, we don't appreciate this artificial tweaking as it muddies the overall view, but we understand that, for end users not accustomed to tuning a platform, the boost could be appreciated.

Aesthetically, the SLI Plus presents well with an almost utilitarian design chic dressed in black with grey tones, highlighted by RGB illumination. It's a simple visual design overall but it works well.

It uses the seemingly ubiquitous Realtek ALC1220 audio codec. However, it lacks the premium DAC and op-amp solution seen on more premium solutions such as the Gaming 9 (far left). But with the price difference, you could get a quality sound card and still have spare cash compared with the Gaming 9 asking price.

If you're wanting to get your foot in the X299 door but wish to do so without breaking the bank, the MSI X299 SLI Plus provides a great, albeit comparatively basic, motherboard solution for that need.

Verdict

Basic features for a HEDT solution met with focused capability. A real winner.

★★★★½

"Even now, we're only experiencing a battle within the middle of a much larger war. And while the battle has been intense so far, it's only going to get more furious."

State of the CPU market

Buy now? Wait longer? What to do? Read on for our recommendations.

If you thought the release of the Intel 200-series chipsets with Kaby Lake-S-based CPUs in January and AMD's disruptive push of its Ryzen CPUs and associated 300-series chipsets in March and April was heating the CPU market up, well, the scenario has just kept ramping up. Now with Intel pushing out its X-series CPUs in a broad range of offerings and updated HEDT platform in the form of the X299 chipset, it's clear that Big Blue wants to dismiss its smaller competitor which hasn't given this much fight for a decade.

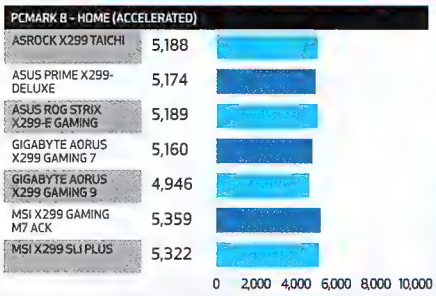
Even now, we're only experiencing a battle within the middle of a much larger war. And while the battle has been intense so far, it's only going to get more furious.

AMD's entry-level solutions in the form of the Ryzen 3 CPU samples have just come through as we go to print. We'll be putting these CPUs through their paces and sharing our insights with you as usual. Yet it's a bigger battle that we are intrigued and excited by. That is, AMD's Ryzen Threadripper, headed by the Ryzen Threadripper 1950X with 16 cores, 32 threads at the price point of Intel's Core i9-7900X. And Intel is ready, with additional Core i9 products launching between the launch of Ryzen Threadripper and October.

Add to the mix rumours that Intel's next consumer micro-architecture update, codenamed Coffee Lake, could drop before the end of the year and 2017 is shaping up to be a year to remember as a mammoth tit-for-tat CPU war.

What do we think at this stage? We can't get enough — bring it on!

LABS BENCHMARK RESULTS


PCMARK 8 - HOME (ACCELERATED)
ASROCK X299 TAICHI 5,188
ASUS PRIME X299-DELUXE 5,174
ASUS ROG STRIX X299-E GAMING 5,189
GIGABYTE AORUS X299 GAMING 7 5,160
GIGABYTE AORUS X299 GAMING 9 4,946
MSI X299 GAMING M7 ACK 5,359
MSI X299 SLI PLUS 5,322
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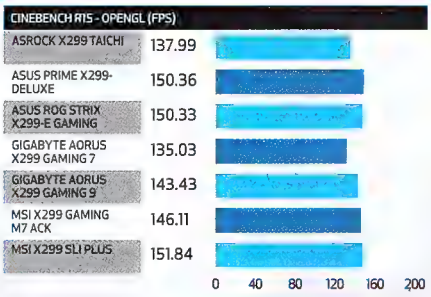
CINEBENCH R15 - OPENGL (FPS)
ASROCK X299 TAICHI 137.99
ASUS PRIME X299-DELUXE 150.36
ASUS ROG STRIX X299-E GAMING 150.33
GIGABYTE AORUS X299 GAMING 7 135.03
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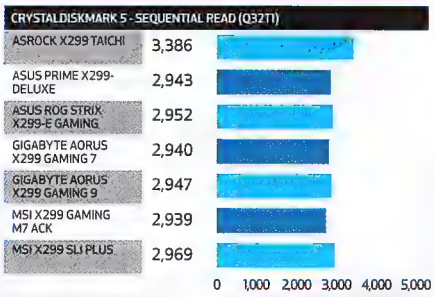
CRYSTALDISKMARK 5 - SEQUENTIAL READ (Q32T1)
ASROCK X299 TAICHI 3,386
ASUS PRIME X299-DELUXE 2,943
ASUS ROG STRIX X299-E GAMING 2,952
GIGABYTE AORUS X299 GAMING 7 2,940
GIGABYTE AORUS X299 GAMING 9 2,947
MSI X299 GAMING M7 ACK 2,939
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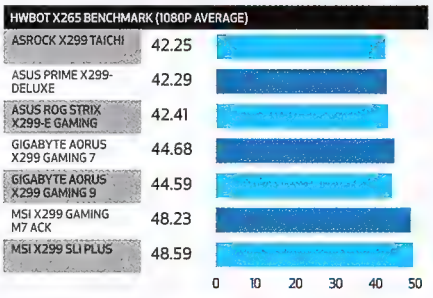
HWBOT X265 BENCHMARK (1080P AVERAGE)
ASROCK X299 TAICHI 42.25
ASUS PRIME X299-DELUXE 42.29
ASUS ROG STRIX X299-E GAMING 42.41
GIGABYTE AORUS X299 GAMING 7 44.68
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MSI X299 GAMING M7 ACK 48.23
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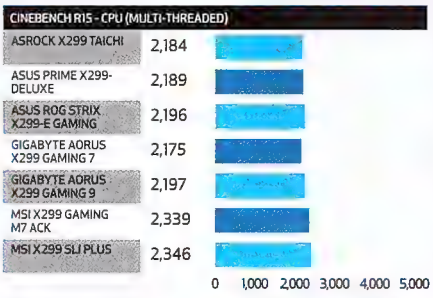
CINEBENCH R15 - CPU (MULTI-THREADED)
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ASUS ROG STRIX X299-E GAMING 2,196
GIGABYTE AORUS X299 GAMING 7 2,175
GIGABYTE AORUS X299 GAMING 9 2,197
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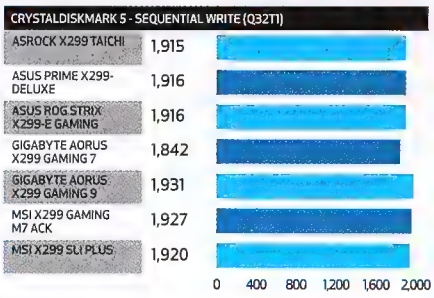
CRYSTALDISKMARK 5 - SEQUENTIAL WRITE (Q32T1)
ASROCK X299 TAICHI 1,915
ASUS PRIME X299-DELUXE 1,916
ASUS ROG STRIX X299-E GAMING 1,916
GIGABYTE AORUS X299 GAMING 7 1,842
GIGABYTE AORUS X299 GAMING 9 1,931
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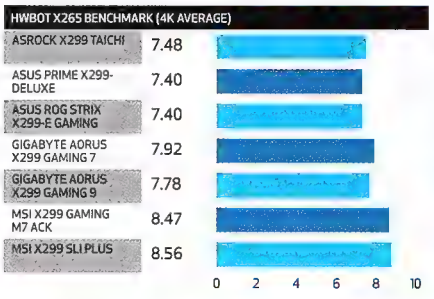
HWBOT X265 BENCHMARK (4K AVERAGE)
ASROCK X299 TAICHI 7.48
ASUS PRIME X299-DELUXE 7.40
ASUS ROG STRIX X299-E GAMING 7.40
GIGABYTE AORUS X299 GAMING 7 7.92
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MSI X299 GAMING M7 ACK 8.47
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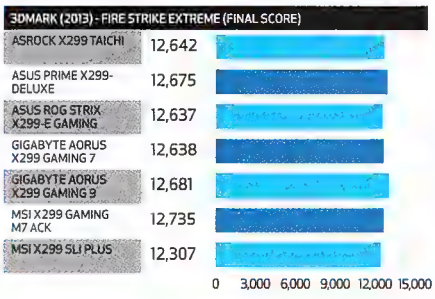
3DMARK (2013) - FIRE STRIKE EXTREME (FINAL SCORE)
ASROCK X299 TAICHI 12,642
ASUS PRIME X299-DELUXE 12,675
ASUS ROG STRIX X299-E GAMING 12,637
GIGABYTE AORUS X299 GAMING 7 12,638
GIGABYTE AORUS X299 GAMING 9 12,681
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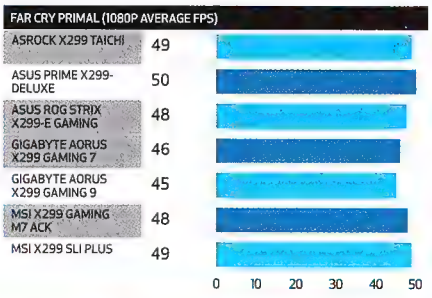
FAR CRY PRIMAL (1080P AVERAGE FPS)
ASROCK X299 TAICHI 49
ASUS PRIME X299-DELUXE 50
ASUS ROG STRIX X299-E GAMING 48
GIGABYTE AORUS X299 GAMING 7 46
GIGABYTE AORUS X299 GAMING 9 45
MSI X299 GAMING M7 ACK 48
MSI X299 SLI PLUS 49
0 10 20 30 40 50

INTEL X299 MOTHERBOARD SPECIFICATIONS

	ASROCK X299 TAICHI	ASUS PRIME X299-DELUXE	ASUS ROG STRIX X299-E GAMING	GIGABYTE AORUS X299 GAMING 7	GIGABYTE AORUS X299 GAMING 9	MSI X299 GAMING M7 ACK	MSI X299 SLI PLUS
PRICE (AT TIME OF REVIEW)	$499	$789	$589	$739	$859	$639	$449
AUDIO CODEC	REALTEK ALC S1220	REALTEK ALC S1220	REALTEK ALC S1220	REALTEK ALC1220	REALTEK ALC1220	REALTEK ALC1220	REALTEK ALC1220
NIC #1	INTEL I219V	INTEL I219V	INTEL I219V	INTEL I219V	INTEL I219V	KILLER E2500	INTEL I219V
NIC #2	INTEL I211-AT	INTEL I211-AT	REALTEK RTL-8822BE 802.11AC	KILLER E2500	KILLER E2500	KILLER WIRELESS-AC 1535 (802.11AC)	INTEL I211-AT
NIC #3	INTEL DUAL BAND WIRELESS-AC 3168 (802.11AC)	QUALCOMM ATHEROS QCA9008-TBD1 (802.11AC/AD)	-	KILLER WIRELESS-AC 1535 (802.11AC)	KILLER WIRELESS-AC 1535 (802.11AC)	-	-
RAM FREQUENCY (UP TO)	DDR4-4266 (OC)	DDR4-4133 (OC)	DDR4-4133 (OC)	DDR4-4400 (OC)	DDR4-4400 (OC)	DDR4-4133 (OC)	DDR4-4133 (OC)
M.2 / U.2	3 x PCIe x4 M.2 (3 x SATA & PCIe3.0 x4 PROTOCOL)	1 x U.2; 2 x PCIe x4 M.2 (1 x SATA & PCIe3.0 x4 PROTOCOL; 1 x PCIe3.0 x4)	2 x PCIe x4 M.2 (1 x SATA & PCIe3.0 x4 PROTOCOL; 1 x PCIe3.0 x4)	3 x PCIe x4 M.2 (2 x SATA & PCIe3.0 x4 PROTOCOL; 1 x PCIe3.0 x4)	3 x PCIe x4 M.2 (2 x SATA & PCIe3.0 x4 PROTOCOL; 1 x PCIe3.0 x4)	1 x U.2; 2 x PCIe x4 M.2 (2 x SATA & PCIe3.0 x4)	1 x U.2; 2 x PCIe x4 M.2 (2 x SATA & PCIe3.0 x4)
SATA	10 x SATA 6GBPS (8 x VIA X299, 2 x VIA ASM1061)	7 x SATA 6GBPS	8 x SATA 6GBPS	8 x SATA 6GBPS	8 x SATA 6GBPS	8 x SATA 6GBPS	8 x SATA 6GBPS
USB3.1	x 2 (1 x TYPE-C, 1 x TYPE-A REAR I/O)	x 5 (1 x TYPE-C, 3 x TYPE-A REAR I/O; 1 x VIA HEADER)	x 3 (1 x TYPE-C, 1 x TYPE-A REAR I/O; 1 x VIA HEADER)	x 6 (4 x TYPE-A, 1 x TYPE-C REAR I/O; 1 x VIA HEADER)	x 6 (4 x TYPE-A, 1 x TYPE-C REAR I/O; 1 x VIA HEADER)	x 3 (1 x TYPE-A, 1 x TYPE-C REAR I/O; 1 x VIA HEADER)	x 3 (1 x TYPE-C, 1x TYPE-A REAR I/O; 1 x TYPE-C VIA HEAER)
USB3.0	x 8 (4 x REAR I/O; 4 x VIA HEADERS)	x 8 (4 x REAR I/O, 4 x VIA HEADERS)	x 8 (4 x REAR I/O, 4 x VIA HEADERS)	x 8 (4 x REAR I/O, 4 x VIA HEADER)	x 8 (4 x REAR I/O, 4 x VIA HEADER)	x 8 (4 x REAR I/O, 4 x VIA HEADER)	x 8 (4 x TYPE-A REAR I/O; 4 x VIA HEADERS)
USB2.0	x 6 (2 x REAR I/O; 4 x VIA HEADERS)	x 6 (4 x REAR I/O, 2 x VIA HEADERS)	x 4 (2 x REAR I/O, 2 x VIA HEADERS)	x 4 (4 x VIA HEADERS)	x 4 (4 x VIA HEADERS)	x 7 (3 x REAR I/O; 4 x VIA HEADERS)	x 8 (4 x REAR I/O; 4 x VIA HEADERS)
LIGHTING HEADERS	2 x RGB HEADERS	1 x RGB HEADERS	2 x RGB HEADERS	2 x RGBW HEADER	2 x RGBW HEADER	1 x RGB HEADER	1 x RGB HEADER
ONBOARD RGB	PCH HEATSINK	PCH, REAR I/O COVER	MID-BOARD HEATSINK, REAR I/O COVER	PCH HEATSINK, REAR I/O SHIELD, AUDIO PCB SECTION, PCIe SLOTS, DIMM SLOTS	PCH HEATSINK, REAR I/O SHIELD, REAR I/O COVER, AUDIO PCB SECTION, PCIE SLOTS, DIMM SLOTS	PCH HEATSINK, REAR I/O COVER, AUDIO PCB AREA COVER, VRM HEATSINK	PCH HEATSINK, VRM HEATSINK
WARRANTY	3 YEARS	3 YEARS	3 YEARS	3 YEARS	3 YEARS	3 YEARS	3 YEARS

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- Auto Failover and Failback
- Simultaneous dual-band wireless 802.11ac 1300Mbps (5GHz) and 802.11n 300Mbps (2.4GHz) support
- 5 Giga Ethernet ports included, port #5 can be configured as Ethernet WAN
- QoS and firewall supported
- 2 FXS ports for SIP VoIP call (option)
- VPN tunnels for IPSec, OpenVPN, GRE, L2TP, and PPTP connections (option)

First International Trading Pty Ltd.

au.billion.com

Fantastic 4-bay NAS boxes

A 4-bay network-attached storage device is the perfect multi-user storage device for today's busy digital homes or small offices. Nathan Taylor tests 10.

A network-attached storage device (NAS) is a wonderful thing. Most people who own a NAS wonder how they ever lived without it. They provide massive amounts of shared storage, as well as common services that even home users can make use of (like media libraries and backup and sync tools). They let you store your photo library in a safer place than your PC's hard drive and they let you quickly browse and stream content to the many media players stationed through the house. And with the rise of the SSD, they've become even more valuable, since you probably have less storage capacity in your PC now than you did a few years ago.

This month, we've taken a long, hard look at some of the 4-bay NAS models currently available on the market. They've come a long way in the last few years. NAS boxes used to run on crummy ARM processors that your mobile phone would have laughed at – now they're a lot faster and more powerful. Many will now go essentially as fast as your network does, while still performing a host of other tasks in the background. It's definitely a good time to be in the market for a NAS.

HOW WE TESTED

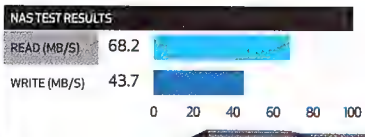
For each device, we performed a simple copy test and measured both the write and the read speed, in megabytes per second (MB/s). All tests bar the Seagate – for which we used the included drives – were performed with three Hitachi 4TB drives installed and set up in RAID 5 (since RAID 5 tests performance more than other modes).

For NASes that supported link aggregation (that's using two Ethernet ports and load balancing across them) we did use both Ethernet ports. However, given the client test device only has a single port, this is not really reflected in the results.

Looking at the results, you'll see a lot that hover in the 90–105MB/s range. This is essentially the NAS maxing out the Ethernet connection, which is where link aggregation comes into play. It means that the NAS likely has more performance to offer for when multiple devices are accessing it simultaneously.

NAS SPECIFICATIONS

PRODUCT	ASUSTOR AS-204T	ASUSTOR AS-3104T	NETGEAR READYNAS RN214	QNAP TS-431P	QNAP TS-451A	SYNOLOGY DS416SLIM	SYNOLOGY DS916+	WD MY CLOUD EXPERT EX4100	WD MY CLOUD PRO PR4100
VENDOR	ASUSTOR	ASUSTOR	NETGEAR	QNAP	QNAP	SYNOLOGY	SYNOLOGY	WESTERN DIGITAL	WESTERN DIGITAL
WEBSITE	WWW.ASUSTOR.COM	WWW.ASUSTOR.COM	NETGEAR.COM.AU	WWW.QNAP.COM	WWW.QNAP.COM	SYNOLOGY.COM	SYNOLOGY.COM	WWW.WDC.COM	WWW.WDC.COM
PRICE	$440	$583	$520	$400	$610	$385	$650	$580	$790
BAYS	4	4	4	4	4	4	4	4	4
PROCESSOR	INTEL ATOM 1.2GHZ DUAL-CORE	INTEL CELERON N3060 1.6GHZ DUAL-CORE	ARM CORTEX A15 1.4GHZ QUAD-CORE	ARM CORTEX A15 1.7GHZ DUAL-CORE	INTEL CELERON N3060 1.6GHZ DUAL-CORE	MARVELL ARM 1GHZ DUAL-CORE	INTEL PENTIUM N3710 1.6GHZ QUAD-CORE	MARVELL ARM 1.6GHZ DUAL-CORE	INTEL PENTIUM N3710 1.6GHZ QUAD-CORE
MEMORY	512MB	2GB (EXPANDABLE TO 8GB)	2GB	1GB	2GB (EXPANDABLE TO 8GB)	512MB	2GB (EXPANDABLE TO 8GB)	2GB	4GB
NETWORKING	1 x GIGABIT PORT	1 x GIGABIT PORT	2 x GIGABIT PORTS WITH LINK AGGREGATION	2 x GIGABIT PORTS WITH LINK AGGREGATION	2 x GIGABIT PORTS WITH LINK AGGREGATION	2 x GIGABIT PORTS WITH LINK AGGREGATION	2 x GIGABIT PORTS WITH LINK AGGREGATION	2 x GIGABIT PORTS WITH LINK AGGREGATION	2 x GIGABIT PORTS WITH LINK AGGREGATION
USB AND OTHER PORTS	2 x USB 3.0 HOST PORTS, 2 x USB 2.0 HOST PORTS	3 x USB 3.0 HOST PORTS, IR RECEIVER	3 x USB 3.0 HOST PORTS, 1 x ESATA PORT	3 x USB 3.0 HOST PORTS	3 x USB 3.0 HOST PORTS, IR RECEIVER, SD CARD READER, USB 3.0 PORT	2 x USB 3.0 PORTS	3 x USB 3.0 HOST PORTS, 1 x ESATA PORT	3 x USB 3.0 HOST PORTS	3 x USB 3.0 HOST PORTS
LOCAL HDMI OUT	NO	YES	NO	NO	YES	NO	NO	NO	NO
OPERATING SYSTEM	ASUSTOR DISK MANAGER (ADM)	ASUSTOR DISK MANAGER (ADM)	READYNAS OS	QTS	QTS	SYNOLOGY DISKSTATION MANAGER	SYNOLOGY DISKSTATION MANAGER	MY CLOUD OS	MY CLOUD OS
OTHER LICENCES	4 x CAMERA LICENCES FOR SURVEILLANCE CENTER	4 x CAMERA LICENCES FOR SURVEILLANCE CENTER	-	2 x CAMERA LICENCES FOR SURVEILLANCE STATION	2 x CAMERA LICENCES FOR SURVEILLANCE STATION	2 x CAMERA LICENCES FOR SURVEILLANCE STATION	2 x CAMERA LICENCES FOR SURVEILLANCE STATION	-	-



$440 | WWW.ASUSTOR.COM

Asustor AS-204T

A low-cost NAS that does the basics well.

A product that's roughly three years old now, the Asustor AS-204T remains one of the few models of Asustor NASes that are widely available in Australia.

In spite of its age, the AS-204T still makes a solid low-cost 4-bay. It won't set anybody's world on fire, and we wouldn't recommend it if you want it to perform heavy lifting like live transcoding or virtualisation, but if you just want a cheap 4-bay with OK performance and a capable operating system, this model gets the job done.

Like Synology and QNAP, Asustor's ADM operating system fully embraces all the capabilities of Linux. It looks and works very similarly to those platforms, and there is a wide variety of third-party applications that can be downloaded and installed on the device, as well as a suite of very handy mobile apps. Because it runs an x86 processor (unlike many other low-cost NAS boxes), the third-party application support is especially impressive, and it supports Docker and virtualisation as well. Of course, given it only has 512MB of memory, the latter is probably not all that useful.

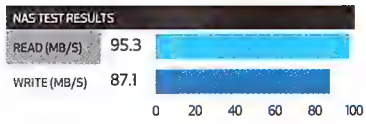
We're also fond of the simplicity of the design. It's not screwless, but it's simple and elegant enough that installing or replacing hard drives is no drama. It has only a single Ethernet port, however, and no fancy HDMI port or eSATA port for expansion.

It's cheap and it's simple and, for many people, that's enough.

Verdict

Don't expect too much from this older NAS model, but it's cheap and has plenty of options.

★★★☆☆



$583 | WWW.ASUSTOR.COM

Asustor AS-3104T

A mid-range NAS and neat media centre.

A considerably newer and more powerful product from Asustor, the AS-3104T is built as both NAS and media centre, with local HDMI output, IR receiver support and additional custom software.

Sporting a dual-core Celeron processor, it's in the mid-range of NASes when it comes to processing power. It will handle most things capably, including 4K transcoding, but it might struggle if you hit it really hard with virtualisation, large numbers of IP cameras and similar tasks. It did well in our performance tests, essentially maxing out the Ethernet link, though it only has a single Ethernet port.

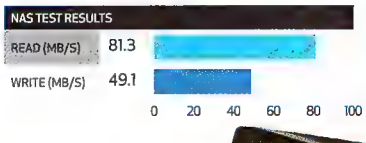
ADM is also an excellent NAS operating system. It's a virtual desktop in the style of Synology DiskStation, with a large range third-party apps. Its first-party apps aren't quite as good as QNAP's, but there are very solid backup tools and an IP camera surveillance manager with four licences. We're really fond of the mobile apps as well.

Its capabilities as a media player are also considerable. Asustor hasn't just slapped Kodi on the NAS and called it a day. There's a proper portal interface for your TV set, with support for Netflix and others. Kodi is there for playing local media, of course. The NAS supports USB TV tuners through the LooksGood app as well, so it functions capably as a PVR. The portal and applications are still rough around the edges and could use a bit of interface design work, but it's really nice to have the options and all the features right there with full remote control support built in (though no remote is supplied).

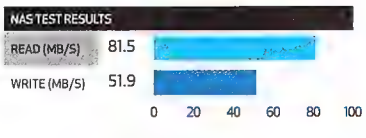
Verdict

It's a little expensive given the hardware specs, but we really like it overall.

★★★★☆



$560 | WWW.NETGEAR.COM.AU



$400 | WWW.QNAP.COM

Netgear ReadyNAS RN214

An easy-to-use mid-range performer.

With a hard black box and LCD display up front, the Netgear is a good looking device, and its easy installation and setup make it a top pick for a lot of users. Its supporting mobile and desktop apps are impressive and the tabbed admin interface will be a lot less scary for a lot of users than the virtual desktop-style.

Most NASes in this price range use x86 processors, which have better application compatibility and generally better performance. On the other hand, Netgear is sticking with ARM, which might limit the availability of some third-party apps. In terms of raw disk performance, it did OK, but fell down a little in the write tests. Otherwise the hardware is solid, with twin Ethernet ports supporting load balancing, USB 3.0 and an eSATA port for expanding the number of drives.

Netgear's admin interface is simple and straightforward. It's a tabbed affair, designed for easy access but with more limited options than you'll find in Asustor or Synology. There are third-party apps that can be installed, and Netgear is popular enough that many software developers offer manual downloads. In general, you won't find as many third-party apps as you will on QNAP, Synology or Asustor, but there's more than you'll have available on Seagate or WD.

On top of that, the mobile and desktop apps are very good. The backup apps in particular make it simple to use the ReadyNAS as a backup target, while media apps for mobile make streaming easy.

Verdict

A solid mid-range performer. It's nicely designed for consumer use, yet still has plenty of options.

QNAP TS-431P

Cheap but capable.

The new player at the low end of QNAP's range, the TS-431P, is an ARM-powered NAS with a neat design and a ton of features. It's a nice step up from the older ARM models like the TS-412, yet retails at a very affordable price. It comes in the QNAP white case, with easy slide-in installation.

As you might expect at this price range, it's hardly a powerhouse. A 1.7GHz dual-core ARM processor and 1GB of RAM definitely place it at the low end of the performance scale, and it's not the kind of device you can ask too much from. It did well enough for disk access, however, rivalling the considerably more expensive Netgear (left). It also has twin Ethernet ports for load balancing.

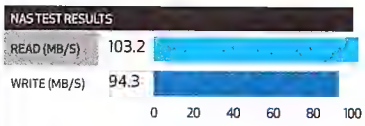
It boasts the latest version of QNAP's QTS operating system, but we think the company has been going backwards with its recent OS releases, with its sometimes scattershot approach to both NAS and mobile applications. The removal of the Twonky Media DLNA server was a big blow (the QNAP DLNA server is bug-riddled and inferior, in our view). There's no question, however, that QNAP has the largest range of first party tools available for the NAS and a third-party toolset to rival any other.

It's the only ARM-based NAS we've seen that supports Docker and LXC, which allow the simple installation of nearly any Linux app. It's still ARM, and the array of third-party Linux apps compiled for the platform is still much more limited than an x86 NAS.

It's still a good NAS for cheap. If you're looking for just-the-basics file services, it's hard to beat.

Verdict

A very capable NAS at a very low price.



$610 | WWW.QNAP.COM

QNAP TS-451A

A NAS box with the lot.

No other NASes in this review can't boast quite the feature set of the TS-451A. QNAP has stacked in an enormous number of extras and unique selling points into the NAS, including HDMI support with an IR remote actually supplied in the box; a USB device port that lets you directly connect the NAS to a PC as if it were a USB hard drive; and even an SD card slot for quick backup or upload. This is a NAS that has every consumer feature you could want.

It runs on a dual-core Celeron with 2GB of memory, which is a little slower than the processor found in the top-end Synology NAS and the WD Pro, but still fast enough for everyday use.

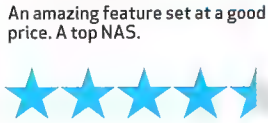
The QTS operating system rivals Synology's DSM as the best in the business. We've found it a little rougher than Synology of late, but in terms of pure functionality, QNAP is hard to beat.

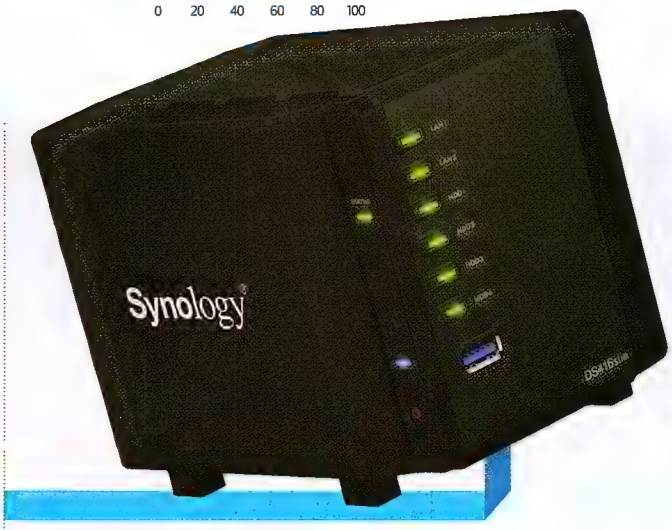
There is a huge suite of third-party apps covering every type of service you could imagine, and that doesn't even account for all the extra apps available through Docker or virtualisation. QNAP's mobile and desktop apps remain a weakness, however, and we usually find we prefer third-party apps like ES File Explorer.

And then there's the direct media support. A very nice remote that works well with Kodi comes in the box, while an HDMI 1.4 slot can output media direct to a TV set in 4K. Asustor has done a better job at customising the interface for TV use (QNAP pretty much just uses Kodi), but the supplied remote is a major seller for QNAP.

Verdict

An amazing feature set at a good price. A top NAS.





$385 | WWW.SYNOLOGY.COM

Synology DS416slim

Neat.

The key selling point of the DS416slim from Synology is right there in the title. The case of the NAS is just big enough to hold the drives, a small 6cm x 6cm fan, and the motherboard – and not much more. It's about as neat as a four-bay NAS can get, and the drives slide right into the back of the NAS giving it a clean look up front.

In order to stay cool, quiet and compact, it uses a low-power ARM processor to drive the NAS. It clocks in at just 1GHz, accompanied by only 512MB of memory. In terms of ports, there are just two USB ports – though it does feature twin Ethernet ports.

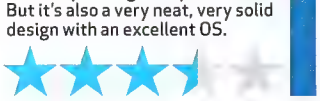
Not that you're likely to get much use out of the twin LAN. The low-end processor struggled with the Synology Hybrid RAID (a version of RAID 5) and the write speed was well below average. It wasn't terrible, and it had no trouble streaming media, but it couldn't compete with the other NASes here.

It runs Synology Diskstation Manager, a powerful OS that it a contender for the best in the business now. Like QNAP and Asustor's operating systems, it presents as a full virtual desktop, windows and tabs and all. Hundreds of first and third-party apps are available, and the suite of first-party tools for media sharing, backup and sync and remote access are first class. It even has a web-based office suite available.

Of course, given the light specifications, you couldn't ask it to run too much. In fact, we probably wouldn't ask it for much more than file services. But if that's all you want, this is a low-cost, attractive little NAS that does the basics well.

Verdict

It's cheap and light on performance. But it's also a very neat, very solid design with an excellent OS.



$650 | WWW.SYNOLOGY.COM

Synology DS916+

More powerful than most.

Synology's DS916+ sits at the pricier end of the consumer scale, but if you want a NAS that can offer the kind of performance you need for virtualisation, 4K transcoding and large scale IP camera monitoring, the DS916+ has the goods.

The heart of the NAS is Synology's excellent DiskStation Manager OS, and the DS916+ has the power to make the most of it. The array of features available is astonishing, including first-party tools for media sharing and web publishing, a virtualisation station, cloud-based chat and word processing, tools for backup and sync, as well as our favourite NAS-based Surveillance app (for which you get two licences in the box). They're all managed via a virtual desktop interface, and can also be accessed through Synology's well-made mobile apps. In short, Synology may not have quite the breadth of features possessed by QNAP (though it's close), but its implementation is a little smoother.

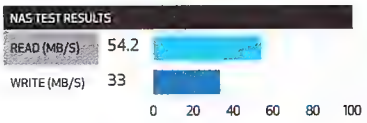
The hardware itself feels wonderfully solid and well designed, making it easy to hot swap disks. There are plenty of USB 3.0 ports and twin Ethernet ports with load balancing. It also has an eSATA port, which you can use to attach additional drive bays, such as Synology's Expansion Units. These are 'dumb' arrays of five or more disks controlled by the host NAS.

Set up using Synology's Hybrid RAID, the DS916+ clocked the best drive performance of any NAS tested here, essentially maxing out the Ethernet link on both read and write operations.

Verdict

A little pricey and without many bells and whistles, but it's powerful and has great software.

★★★★☆



$580 | WWW.WDC.COM

WD My Cloud Expert EX4100

Nope.

We have very fond memories of the original ShareSpace. In spite of being released nearly a decade ago, it was a fantastic consumer NAS. Sure, it didn't perform well, but not many devices did back then.

Since then, WD's NAS design seems to have gone backwards. The sleek design of the ShareSpace has been replaced by a more utilitarian look, the front LCD notwithstanding. The friendly firmware has been replaced by something a little less accessible (though slightly more capable). And the NAS has failed to keep up with the times in terms of functionality.

WD's operating system, My Cloud OS, is not bad if you're looking for simplicity. It's very much in the tabbed settings style of Netgear's NASes, eschewing the "Welcome to Linux!" look of QNAP and Synology. That makes it more accessible than those platforms, but also less capable. The suite of third-party apps and add-ons is comparatively paltry, and quite a few major features are missing – such as IP camera surveillance and web media publishing. That said, the mobile and desktop apps provided by WD are quite good.

The EX4100 is burdened with the relatively weak Marvell ARMADA 388 1.6 GHz dual-core processor. ARM processors are common in low-cost NASes, but the EX4100 is not a low-cost NAS.

In all, it's hard to find anything particularly redeeming about the WD. It's not terrible – it does what WD says it does – but that's not nearly enough when the competition is cheaper, faster and more capable.

Verdict

Way too expensive for what's in the case.

★★☆☆☆

$790 | WWW.WDC.COM

WD My Cloud Pro PR4100

A Lamborghini in a school zone.

The Pro PR4100 is essentially an upgraded version of the EX4100 (apparently Pro > Expert). It uses the exact same chassis, has the same ports and an identical LCD and firmware. Visually, you can only tell them apart by the model stickers on the front.

All the improvements are on the inside. Most notably, the weak ARM processor of the EX4100 is replaced by a relatively powerful Pentium processor, and the amount of RAM is doubled. This gives the My Cloud Pro considerably better performance, and it essentially maxed a Gigabit Ethernet connection when we tested it.

But many of the same fundamental problems we had with the EX4100 remain here. It uses the exact same firmware and has a similarly limited suite of third-party apps available for it. The apps are a little different because it uses an x86 processor, but it's well behind the competition. When QNAP, Synology and Asustor have conveniently packaged dozens of different Linux apps for their NAS boxes, it's quite clear that WD has not put in the effort.

It does thankfully have Plex available, and the availability of the excellent Acronis True Home server for backup is a serious selling point, but otherwise there's not that much here.

It's a shame, because the hardware driving this NAS is fair. The processor is powerful enough to do a lot more, but WD fails to do that. The PR4100 makes a perfectly good file and media server and an excellent backup target, especially with the supplied backup software. But if you want to do more than that, look elsewhere.

Verdict

Other NAS boxes offer more for less.

★★½☆☆

Five tips for setting up your NAS

For a first timer, a network-attached storage device can be a daunting prospect. They can initially seem complicated, and it's not always clear what the best settings are. So here are five quick tips to get you started.

1 Fill the hard drive slots straight away. You might think that you can progressively add hard drives to the NAS, and technically you can, but rebuilding volumes or using multiple volumes is an absolute pain. The best thing to do straight away is fill up all slots with hard drives of the exact same size (if they're not the same size, then a lowest common denominator rule can apply). Right now, the cost/capacity sweet spot for hard drives is in the 3–6TB range.

2 Use RAID 5 (or Synology Hybrid RAID) volumes. This tip is really only for people with 3-bay or larger NASes. When you're initially creating your NAS volume during the setup process, select RAID 5. RAID 5 gives you the best balance between reliability and capacity. Essentially, you lose the capacity of one drive (so four 5TB hard drives would make a 15TB volume), but if any one of the hard drives fails your will lose no data, and you can just hot swap in a replacement.

3 Create individual user folder permissions. One of the first things you should do with your NAS is go to the user settings and create a user account for every person who might be using the NAS. Then you create folders and set folder permissions. Each user might have their own private folder for personal data. Then you might create a 'Family' folder and give everyone read/write permission. Then a 'Parents' folder for sensitive content and give access permission only to grown ups. Finally, you can create Media folders where you store your shared photos and videos.

4 Make sure you download and use the mobile and desktop apps. Most NASes are managed through a web interface and accessed using standard protocols and that's fine. But every NAS manufacturer also has a suite of mobile and desktop tools they provide as well, and you should absolutely check these out. Take a look at the manufacturer's we site, and do a search for the manufacturer's name on Google Play or the iTunes App Store. You may find tools for remote access the NAS's contents, tools for simplified backup straight to the NAS, media playback tools and much more. It's often easier than trying to figure out how to use third-party tools to do the same.

5 Explore the first and third-party NAS apps in the App Store/Package Center. All NAS boxes come with some basic services built-in and switched on. But every manufacturer also allows third-party apps to be installed on the NAS, and these apps can do a lot of different things. There are apps that will sync your NAS's contents with cloud services, apps for creating home telephony networks, apps for monitoring and recording IP camera feeds, apps for automatically downloading BitTorrent files and much more. There are also excellent media servers like Plex available for most platforms. ■

USB external storage: the best drives we've tested

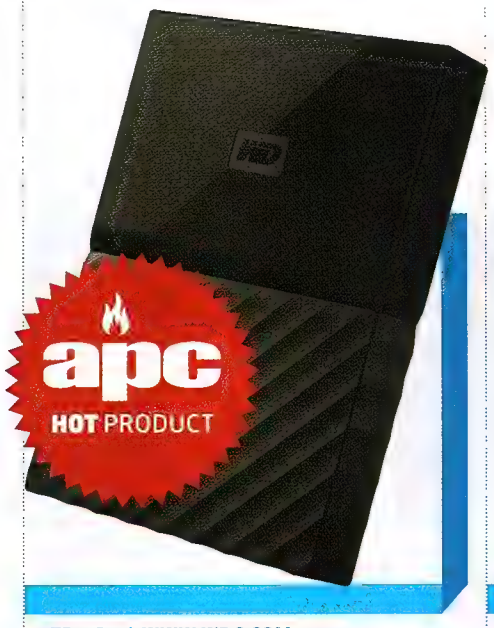
For this month's USB hard drive round-up, Joel Burgess singles out our five currently-available favourites to make finding the right one for your needs super-simple.

The hard disk drive category is one of the slower moving tech spaces these days. Prominent vendors update the product ranges once every couple of years, but with prices, capacities and speeds all maintaining current rates, it's difficult have any significant innovation.

Last year, a number of vendors brought out wireless storage drives, Seagate launched an 8TB desktop drive that is powered and connected through the same USB Type-C cable, and dual HDDs in a fast RAID 0 configuration have all but dropped out of the market with the growth of external SSDs (Seagate no longer sells its popular Backup Plus Fast locally).

Prices can vary considerably from vendor to vendor on portable and desktop HDDs, so while we kept the listed costs pegged as low as we could find from the major local retailers, it's worth shopping around as much as possible.

Below are our picks for the best USB hard drives, which we've chosen across a range of five handy sub-categories.



1TB, $89 | WWW.WDC.COM

BEST VALUE

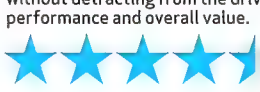
WD My Passport 1TB

Travel to a more valuable storage solution.

The portable storage space is a clear example of economies of scale, which demand that when you buy more of something, the cost per unit falls, but for most, a terabyte or two is enough, even if it comes at a premium. While generally you're looking at paying anywhere between $90 and $110 for a 1TB portable drive, WD's My Passport sneaks in just under that at $89. You can save $10–20 on elemental drives that generally hold up reasonable read and write speeds, but you'd miss out on the security and backup software that the My Passport comes bundled with. WD released its revamped My Passport drives in 2017 with a Maxibon-like, half-smooth/half-textured plastic exterior, which is so square you can securely stack the 117g bricks on top of one another without worrying if they'll topple. With a sustained read speed of 114.5 MB/s and write speeds of 110.1MB/s, the new My Passport is in the middle of the road when it comes to transfer rates, but it's respectable for the budget end of the HDD market.

Verdict

The revamped My Passport range adds spunk without detracting from the drive's performance and overall value.



5TB, $277 | WWW.SEAGATE.COM/AU

BEST HIGH-CAPACITY

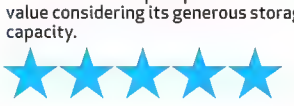
Seagate Backup Plus Portable 5TB

Mass storage on the go.

Most gaming laptops come with 1TB of HDD storage while professional ultrabooks often end up with significantly less than that, so 5TB is a lot of storage space. In fact, this is the largest capacity portable drive available to consumers, apart from maybe the Seagate USB-C powered Innov8 drive (which is really a desktop drive that draws power through USB-C). Encased in black, silver, red or blue metal, this relatively compact 2cm-thick drive fits neatly into a slightly frumpy plastic casing. While it's not the most sleek looking device, its strengths in other areas more than make up for the squarish design. The high data density means this 5TB unit was able to achieve a 10% speed boost over comparable drives we've tested in the past. The device's sequential read and write speeds were a high 143MB/s and 134MB/s, using CrystalDiskMark 3.0.4. Not only is it unusually generous, it's also reasonably priced with the 4TB going for as little as $215 online and the 5TB model for $277 from Kogan.

Verdict

This fast and compact portable drive is great value considering its generous storage capacity.



1TB, $100 | WWW.SEAGATE.COM

BEST ULTRAPORTABLE

Seagate Backup Plus Ultra Slim 1TB

Storage that disappears into air.

Sliding in at a skinny 7.6mm, the metallic-cratered exterior of the Backup Plus Ultra Slim is just half a centimetre thicker than the company's inside-out portable drive, the Seagate Seven, which is so thin you can see the shape of the drive itself. This makes the Backup Plus Ultra Slim as compact as HDDs come but without the added cost of R&D for a unique housing.

With sequential read and write speeds around the 129MB/s mark on CrystalDiskMark benchmarks, Seagate's mainstream ultra-portable drive is also quicker than most of the drives we've tested by about 15MB/s.

You could argue that even the slimmest portable HDD has twice the footprint of portable SSDs, but at $109 for 1TB of space, the Seagate Backup Plus Ultra Slim is around the sixth the price of a similarly sized portable SSD.

When you pitch it that way, the slightly larger 159g, 12.1 x 11.4cm model will be more than compact enough for most.

Verdict

A well-priced hard drive, which is slim on every front, except maybe in title.

★★★★½

2TB, $338 | WWW.WDC.COM

BEST WIRELESS

WD My Passport Wireless Pro 2TB

Your very own portable cloud.

WD has attempted to avoid earlier missteps in the wireless hard disk drive category by focusing on creating a device that will appeal to pro photographers and videographers. The Wireless Pro draws on the dual band 802.11ac WiFi spec to quickly and consistently transfer files while an SD card reader offers the option of fast backups or transfers without needing a PC middleman. To do this without any wires, the device comes with a 10-hour battery lifespan that can be used as a 6,400mAh backup power bank, if you need it. Using the faster 5GHz Wi-Fi connection and a competent app, the Pro managed to transfer 6.7MB/s in real-world testing over Wi-Fi and around 115MB/s read and write speeds using a cabled connection. The advanced tech and superior software integrations make this more expensive, but it the updated WiFi makes the file transfer rates fast enough to be useful and adds functionality like FTP connectivity and syncing with a compatible camera.

Verdict

A pricy drive that offers convenient storage solutions away from the desk.

★★★★½

8TB, $374 | WWW.SEAGATE.COM

BEST DESKTOP

Seagate Backup Plus Hub

Hubba Hub-ba.

Desktop external storage hasn't seen the same dramatic capacity increases as portable drives in past years, and though 8,000GB of disk space is not an insignificant amount, it's not quite revolutionary for an external desktop-bound drive. That said, the 8TB Backup Plus Hub excels in terms of value, speed, size and features.

On the beveled front edge of this desktop drive's plastic case are a pair of USB 3.0 ports that double as conveniently-located places you can charge a phone or tablet or, alternately, plug in portable USB drives to backup to the Hub's own internal storage.

There's naturally a bit of a speed boost associated with bigger 'desktop' external drives (at least compared to their portable cousins) and the Hub's sequential read and write speeds of 198MB/s and 188MB/s are testament to that. At $374, this 8TB drive also works out to be exceptionally good value and, with the additional hub perks, this is one highly-desirable digital storehouse.

Verdict

A fast and affordable proposition for those requiring a generous storage upgrade.

★★★★★

Other USB hard drives

ADDITIONAL DRIVES WE ALSO TESTED, BUT WHICH DIDN'T QUITE MAKE THE CUT TO BE IN OUR TOP FIVE...

G-Technology G-Drive (with Thunderbolt)

3TB, $299.95 | WWW.G-TECHNOLOGY.COM

This sleek-looking storage option isn't the most compact desktop drive, but it does push reasonable read and write speeds. It tends to be sold in Apple stores and commands even bigger markups than the premium retailer's own products.

G-Technology G-Drive ev ATC

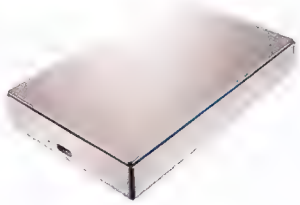
1TB, $319.95 | WWW.G-TECHNOLOGY.COM

The ev ATC range is the fastest 'rugged' drive we've seen and its unique waterproof casing includes a conveniently inbuilt thunderbolt cable. Keep in mind, G-Drive's range isn't compatible with Windows Devices out of the box.

G-Technology G-Drive Mobile

500GB, $129.95 | WWW.G-TECHNOLOGY.COM

Slightly chunkier than your average ultra-slim drive, the G-Drive Mobile USB is one of the only portable drives we've seen with two FireWire and a USB output, so even though it is encased in a stock standard metal enclosure it does have at least one unique feature.



G-Technology G-Drive Mobile USB-C 1TB

1TB, $159.95 | WWW.G-TECHNOLOGY.COM

The speeds of external drives are limited by the physical speeds of spinning disks, so the USB Type-C only adds compatibility. The actual disk drive in this particular unit is quicker than most, though, with read and write scores around the 130MB/s mark.

LaCie Porsche Design Mobile Drive

1TB, $97 | WWW.LACIE.COM

At 137MB/s and 134MB/s sequential read and write speeds, the Porsche is between two and three times slower than the speediest flash drives, and when you put it up against Seagate's $160 2TB Backup Plus Ultra Slim drive, it's less than 5% faster overall.

LaCie Rugged USB-C 1TB

1TB, $209.95 | WWW.LACIE.COM

If you need to keep your data safe from the elements, there are a few options available, but LaCie is going to be one of the more reliable (if a little pricy) options with its water, pressure and shock resistant rugged USB-C drive.

USB HARD DRIVE SPECIFICATIONS & TEST RESULTS

PRODUCT	G-TECHNOLOGY G-DRIVE (WITH THUNDERBOLT)	G-TECHNOLOGY G-DRIVE EV ATC	G-TECHNOLOGY G-DRIVE MOBILE	G-TECHNOLOGY G-DRIVE MOBILE USB-C	LA CIE PORCHE DESIGN PORTABLE DRIVE	LACIE RUGGED USB-C	SEAGATE BACKUP PLUS HUB	SEAGATE BACKUP PLUS PORTABLE
SCORE	2	3	2/5	3	2.5	3	4.5	5
CATEGORY	DESKTOP	RUGGED	VALUE	TYPE-C	TYPE-C	RUGGED	DESKTOP	CAPACITY
PRICE	4TB, $549.95; 6TB, $699.95; 8TB, $980; 10TB, $1,220	$319.95	500GB, $129.95; 1TB, $149.95	$159.95	1TB, $189; 2TB, $259; 4TB, $399	1TB, $209.95; 2TB, $299.95; 4TB; $419.95	$419	$319
SIZES	4TB, 6TB, 8TB, 10TB	1TB	500GB, 1TB	1TB	1TB, 2TB, 4TB	1TB, 2TB, 4TB	4TB, 6TB, 8TB	4TB, 5TB
TEST SIZE	4TB	1TB	1TB	1TB	4TB	2TB	8TB	5TB
$/TB RATIO (BASED ON TEST SIZE)	137.5		149.95	159.95	64.75	150	52.4	63.8
DIMENSIONS (cm)	23.5 x 12.5 x 4.5	20.4 x 15.4 x 5.21	12.7 x 8.3 x 1.8	12.9 x 8.2, 1.3	12.8 x 8.4 x 1	13.5 x 8.6 x 1.9	19.8 x 11.8 x 4.1	11.5 x 7.8 x 2
WEIGHT (g)	1,351		410	170	190	270	1,060	247
INTERFACE	THUNDERBOLT/ USB 3.0		USB 3.0/ THUNDERBOLT	USB 3.1	USB 3.0, & 3.1	USB TYPE-C/A (THUNDERBOLT & 3.1)	USB 3.0	USB 3.0
SEQUENTIAL READ (MB/S)	139	136.1	104.7	135.4	137.7	141.5	197.9	143
SEQUENTIAL WRITE (MB/S)	124	130.4	102.3	128	134	122.9	188.2	134.6
512MB READ (MB/S)	40.7	N/T	N/T	N/T	45.21	41.24	55.64	42.23
512MB WRITE (MB/S)	94.1	N/T	N/T	N/T	98.53	103.6	95.82	72.33

Seagate
Backup Plus Slim 1TB

1TB, $88 | WWW.SEAGATE.COM
At 1.21cm thick, the Backup Plus Slim from Seagate is only a few millimetres thicker than the Backup Plus Ultra Slim, so the more price-savvy consumer would probably opt for the $10–15 savings on this unit.

Toshiba
Canvio Basics

1TB, $90 | WWW.MYTOSHIBA.COM.AU
While the initial pricing on this drive was excellent, as others go on sale and this unit is dropped from competitively priced retailers, it's ended up aligning closely with other HDDs that come with backup and security software.

Toshiba
Canvio Connect II

1TB, $88 | WWW.MYTOSHIBA.COM.AU
The Canvio Connect II bundles in a time-limited subscription to Pogoplug PC, so the drive can be used as a cloud storage system if you would prefer. This inclusion seems a little unnecessary, but the additional software doesn't hurt.

Toshiba
Canvio Premium

1TB, $109 | WWW.MYTOSHIBA.COM.AU
A fast, premium-looking drive at a reasonable price that sweetens the deal with a metal case, a black velvety bag and a USB A-to-C adapter. Also bundled is a HDD hardware encryption tool, NTI backup software and the Pogoplug PC app.

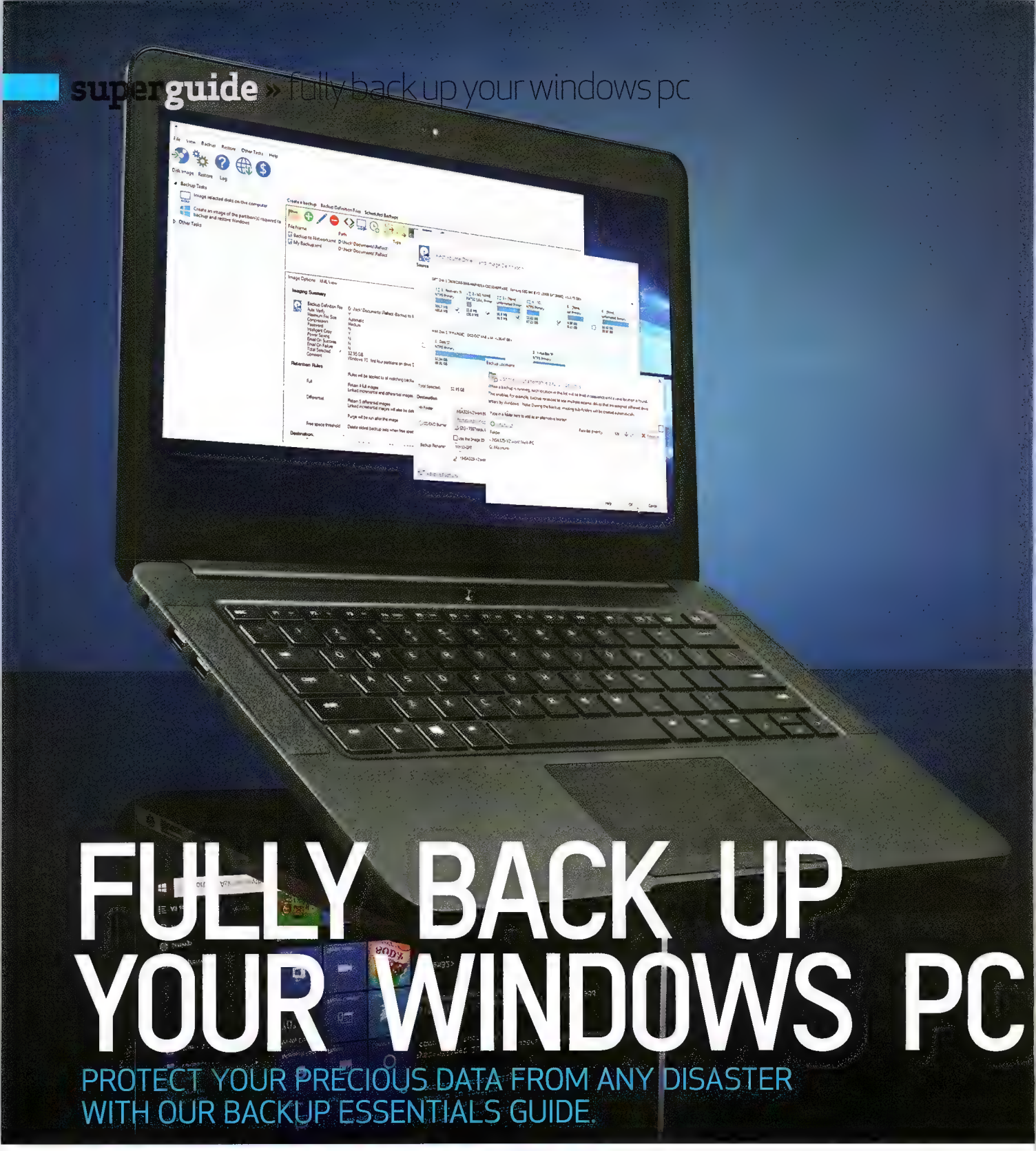
WD
My Book Duo

4TB, $450 | WWW.WDC.COM
This monster desktop drive uses two big hard disk drives in a RAID 0 configuration for over 330MB/s read speeds and write speeds of 184MB/s for a reasonable price. A very compelling offer.

WD
My Passport Ultra

1TB, $69 | WWW.WDC.COM
The My Passport Ultra is showing signs that it might be time for an upgrade, with retailers stockpiles dwindling and plenty on the sale table, but it's not a bad drive if you can still get one.

SEAGATE BACKUP PLUS SLIM	SEAGATE BACKUP PLUS ULTRA SLIM	TOSHIBA CANVIO BASICS	TOSHIBA CANVIO CONNECT II	TOSHIBA CANVIO PREMIUM	WD MY BOOK DUO	WD MYPASSPORT	WD MY PASSPORT WIRELESS PRO	WD MY PASSPORT ULTRA
4	4.5	3	3.5	3	4.5	4.5	4	4
VALUE	ULTRA PORTABLE	VALUE	VALUE	ULTRA PORTABLE	DESKTOP	VALUE	WIRELESS	ULTRA PORTABLE
500GB, $69; 1TB, $89; 2TB, $129	1T, $94; 2T, $138	1TB, $90; 2TB, $129	1TB, $88; 2TB, $136	1TB, $109; 2TB $156	4TB, $429; 12TB, $849; 16TB, $999	2TB, $149; 4TB, $229	$388	$69
500GB, 1TB, 2TB	1TB, 2TB	500, 1TB, 2TB	500, 1TB, 2TB, 2.5TB, 3T	1TB, 2TB	4TB, 8TB, 12TB,16TB	1TB, 2TB, 3TB, 4TB	1TB, 2TB, 3TB, 4TB	1TB
2TB	2T	2TB	2TB	2TB	12T	4TB	3TB	1TB
64.65	69	64.5	68	78	70.75	57.3	129.3	69
11.3 x 7.6 x 1.21	11.3 x 7.6 x 0.96	11.9 x 7.9 x 1.5	10.9 x 7.8 x 1.4	11 x 2.2 x 8.2	15.7 x 9.9 x 16.5	11 x 2.1 x 8.1	12.6 x 12.6 x 2.3	11 x 8.1 x 1.5
159	159	210	149	250	2,300	250	450	150
USB 3.0	USB 3.0			USB 3.0 (TYPE-C ADAPTER)		USB 3.0	802.11AC/MICRO + USB 3.0	MICRO +
116.2	129	116.4	115.9	119.8	331.7	114.5	118.1	113.9
114.6	128.2	114.2	115.5	118.9	184.2	110.1	115.1	112.8
39.56	44.69	42.21	41.15	41.28	53.68	42.31	42.81	44.07
48.7	87.73	47.27	49.32	50.28	34.22	111.8	77.56	62.24



FULLY BACK UP YOUR WINDOWS PC

PROTECT YOUR PRECIOUS DATA FROM ANY DISASTER WITH OUR BACKUP ESSENTIALS GUIDE.

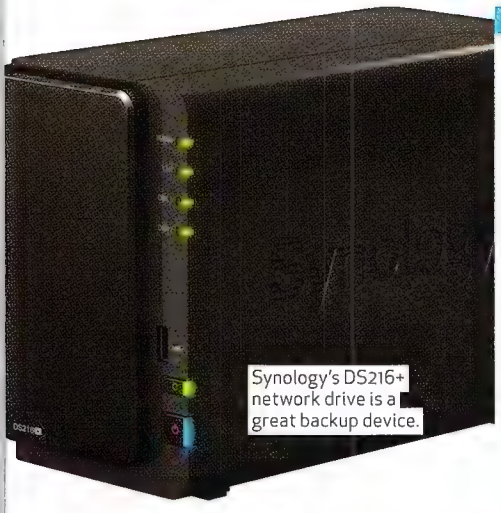
Backing up may not be the most glamorous of subjects, but it's well worth paying attention to. Think about what your data is worth. Some files are more valuable than others – it could be a matter of the time taken to create a document, while other files, such as photos hold sentimental worth.

Most people know the importance of backing up, but can you be sure your backup plan is up to scratch? Many people keep one backup copy of their files, but what happens if it is destroyed along with the original? Seeing as most people keep their backup drive in the same location as their PC, that's not a fanciful notion.

We'll help you create a multi-layered backup of your data, ensuring it's stored in at least two separate locations, and preferably more. We'll reveal the best tools to use – both Windows' own backup tools, as well as great third-party tools. We'll also look at backing up your entire system drive, so if you run into problems, you can roll back to a working Windows installation without having to reinstall.

These days, keeping at least one backup in a remote location usually means taking advantage of cloud-based services, such as Dropbox or Microsoft's OneDrive. There are many potential issues with relying on third parties, whether it's security, constantly changing pricing plans, or what happens to your data if the company ceases trading. If these are deal-breakers, we'll look into alternatives, from sharing backup space with family members to setting up your own encrypted cloud storage, where you have no worries about subscriptions.

We'll also make sure you know what to do should disaster strike and you need to restore a copy of your data.



Synology's DS216+ network drive is a great backup device.

You may already have a basic backup plan in place – Windows 10 makes this easy by offering you two routes, including both 'Backup and Restore' from Windows 7, and 'File History' from Windows 8. They're easy to access and set up – search the 'Start' menu or Cortana for 'backup'. Both focus on producing backups of key documents, photos and other data, and can back up to any drive that's visible to your PC, including network-attached storage.

Rule one of our backup strategy is to make use of multiple backup locations (see 'Select your backup device', top right). Neither 'File History' nor 'Backup and Restore' allow you to back up to alternate locations, but if you're running Windows 10, you can employ both together to get around this restriction. Configure 'File History' to back up to one location – we recommend a drive physically attached to your PC – and use 'Backup and Restore' to back up to another drive, preferably a shared folder on your network drive. 'File History' constantly monitors for changes and backs up as necessary, while you should schedule 'Backup and Restore' to run weekly at a time that won't interfere with PC use.

SYSTEM BACKUPS

Your data is taken care of, but what about Windows? If disaster strikes, you could find yourself spending days getting your PC set up again – but if you take a full system backup (known as a 'drive image'), you can have your PC up and running again within an hour.

Windows offers to create a system image when you set up 'Backup and Restore', but there are weaknesses. First, each backup requires tens of gigabytes of space on your PC. Second, images aren't verified when they're created, so you've no way of knowing if you can rely on them. And third, images are only stored on a single drive.

Eliminate all three weaknesses by employing the services of our favourite drive-imaging tool, Macrium Reflect. We've used it to back up (and rescue)

Select your backup device

When it comes to choosing where to back up your files to, you're spoiled for choice.

But it's not a case of either this backup device or that one — ideally, you should invest in at least two separate devices. Here's what to look for.

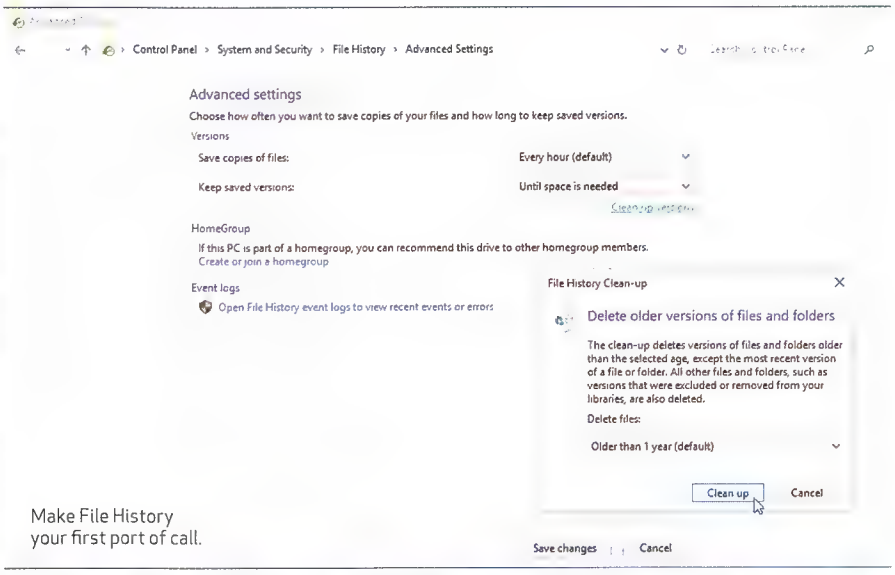
Secondary hard drive: This can be internal or external (USB). Use it for your primary file and drive image backups, using Windows' own tools and Macrium Reflect Free.

Network hard drive: A good secondary solution that can be kept elsewhere in your home for added security. Perfect for any of the backup methods we discuss here — you can even use it as the basis for your own personal cloud storage system using OwnCloud.

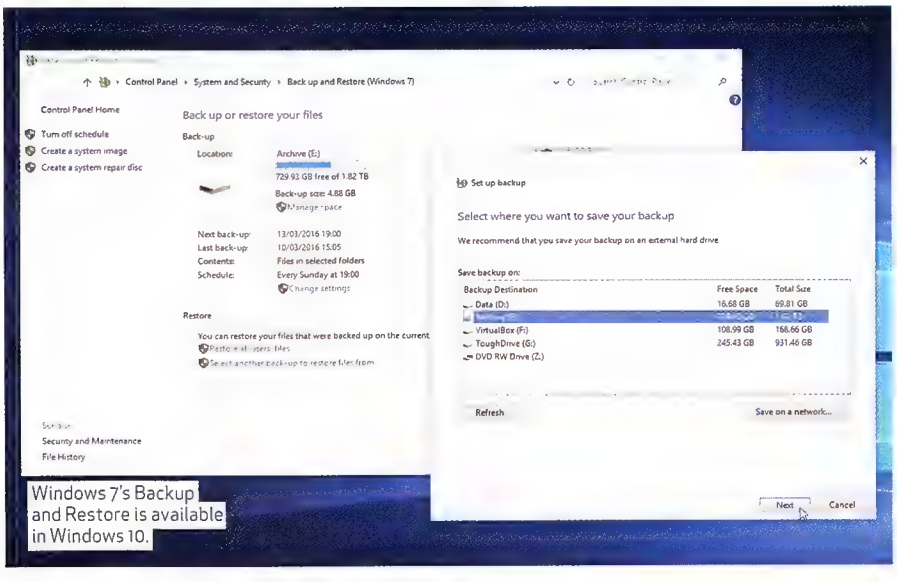
Other computer: If you own another PC (or Mac), keep your key files in sync on all your computers using a cloud storage service or Syncthing. As an added bonus, the latest version of your data is always available on whichever PC you're using.

Friend's or family computer: You can swap unused storage space with people you trust, but make sure your data is kept in an encrypted format on their computer — use Buddy Backup or Viivo in conjunction with Syncthing.

Cloud storage: If you have a fast, unlimited internet connection, using a trusted service, such as Dropbox, Microsoft OneDrive, or Google Drive is also an option. Again, use Viivo to encrypt sensitive data for extra security.


Control Panel › System and Security › File History › Advanced Settings
Advanced settings
Choose how often you want to save copies of your files and how long to keep saved versions.
Versions
Save copies of files:
Every hour (default)
Keep saved versions:
Until space is needed
HomeGroup
If this PC is part of a homegroup, you can recommend this drive to other homegroup members.
Create or join a homegroup
Event logs
Open File History event logs to view recent events or errors
File History Clean-up
Delete older versions of files and folders
The clean-up deletes versions of files and folders older than the selected age, except the most recent version of a file or folder. All other files and folders, such as versions that were excluded or removed from your libraries, are also deleted.
Delete files:
Older than 1 year (default)
Clean up
Cancel
Save changes
Cancel

Make File History your first port of call.



Windows 7's Backup and Restore is available in Windows 10.

Windows countless times over the past five years, and nothing comes close to it. Start with the powerful Free version at **www.macrium.com/reflectfree.asp**, which solves the issue with space by using differential images that take up much less room by only recording the changes made since the last backup was taken.

Launch Macrium Reflect Free once installed, and click 'Create an image of the partition(s) required to backup and restore Windows'. Next, set your destination – a folder on your backup drive. You might want to change the file name to something more easily recognisable, and take the time to click 'Advanced Options' to select 'Auto Verify Image' to ensure your backup is checked for errors after it's been taken. Once done, pick a backup schedule – we recommended pairing one monthly full backup with weekly differential backups, or choosing the 'Differential Backup Set' template for more frequent daily backups. Click 'Next' followed by 'Finish'.

In the spirit of data redundancy, you should then repeat the process, creating a second definition rule pointing toward your secondary backup drive – speed things up by right-clicking the rule you just created and choosing 'Duplicate'. Don't forget to create the rescue media (DVD or 4GB USB flash drive) when prompted by Macrium – this ensures you'll be able to restore your system even if Windows won't boot.

If you want more features – including incremental backups, and the ability to back up files and folders – upgrade to Macrium Reflect Home Edition.

THE POWER OF THE CLOUD

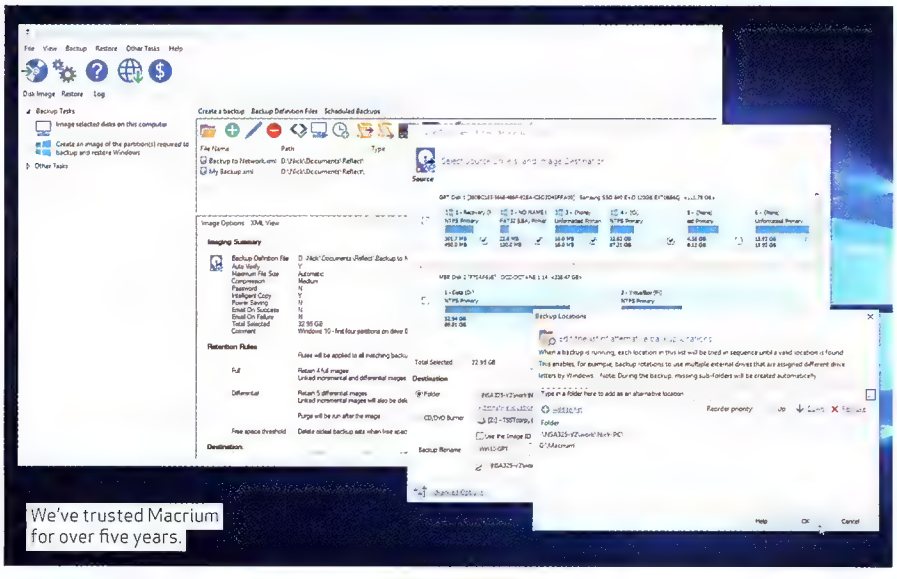
These days, backups are synonymous with the word 'cloud', the logic being that storing backups in the cloud ensures one copy of your data is kept off-site in a secure location in case of fire, theft or worse. It makes sense, although there are some drawbacks. The obvious choice when backing up to the cloud is to employ a known solution – Microsoft's OneDrive service is baked into Windows 10, but alternate trusted sources include Dropbox (**www.dropbox.com**) and Google Drive (**drive.google.com**).

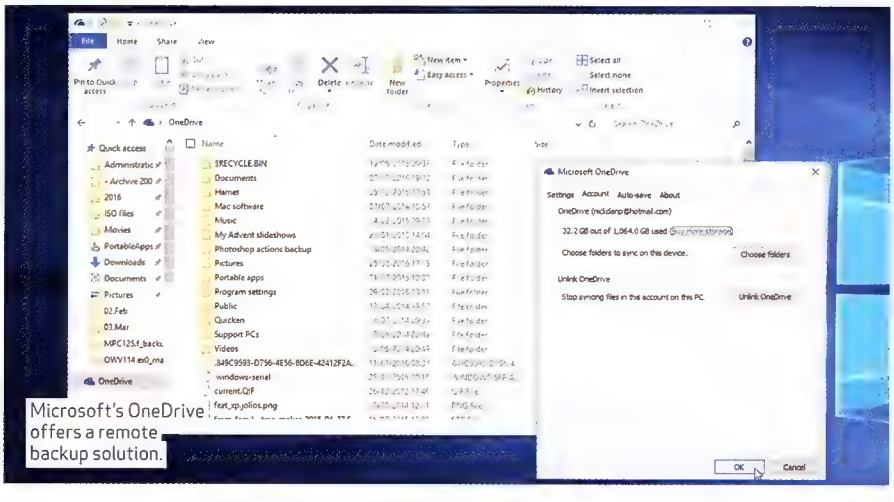
Each service offers limited free plans of around 5–15GB of free storage space, which is fine for personal files, such as documents, photos and even some video, but if you run out of space, you'll need to upgrade to a monthly or annual subscription. One of the best value solutions is to install Office 365 – your subscription includes 1TB of cloud storage and access to the latest version of Microsoft Office for up to five users.

However, there are some reasons to treat cloud storage with suspicion. These include ongoing costs, the security of your data, and what happens if the company in question either goes out of business or discontinues its product, as users of Wuala and AVG LiveKive cloud storage services have discovered to their cost over the years.

In terms of fees, consider prioritising what data you store in the cloud – do you need your videos backed up online, for example? As you have a local backup in place, you could focus on storing important documents and photos in the cloud, where you're unlikely to run out of space quickly. That way, you can usually get away with free storage plans.

If you don't trust your cloud provider's encryption, add a secondary layer of encryption to sensitive files before uploading them to the cloud. The best tool for this purpose is Viivo (**viivo.com**), which works with multiple cloud providers, and includes tools for sharing access to files with family and friends. It's free for personal use, but make sure you keep a separate, unencrypted backup of this data somewhere safe, too, to ensure you're not locked out of your files.


We've trusted Macrium for over five years.


Microsoft's OneDrive offers a remote backup solution.

ALTERNATE STRATEGIES

There are two main alternatives to putting your data in the hands of a third-party provider. Both can be used over the internet if you have a fast and unmetered connection, but you can also use them exclusively over your local network, too, ensuring your data never touches the cloud in any shape or form.

The first of these options involves syncing data from selected folders directly between two or more computers. It works over your local network, as well as the wider internet, if necessary. It's perfect for keeping files in sync between computers you own, and creates a copy of your files, so there are no issues with proprietary file formats. Naturally, the connection is encrypted, and the software is open source.

The program in question is called Syncthing, and it works across Windows, Linux and Mac, and can even be directly installed to selected network drives. We recommend installing the GTK build from **github.com/syncthing/syncthing-gtk** – install it on both computers, then select the folder you wish to sync on your main computer, before connecting it and your

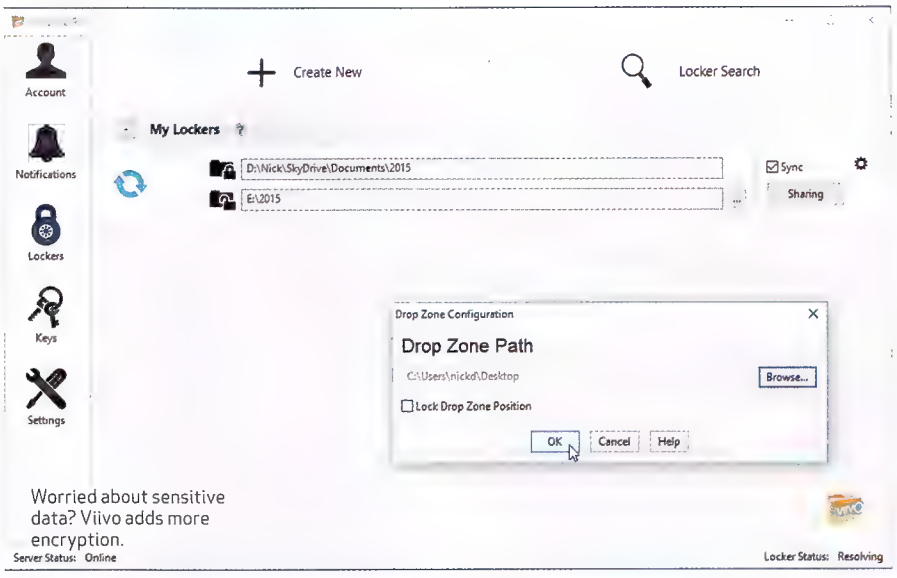
other PC together. Once done, the files are kept in sync automatically whenever Syncthing runs – configure it to start with Windows, to ensure it's always backing up.

Files are transferred directly between computers, so they both need to be on and connected for files to sync. If you wanted to store backups remotely on other PCs, take a look at BuddyBackup (**www.buddybackup.com**), which encrypts your data so it's unreadable on the computers you back it up to.

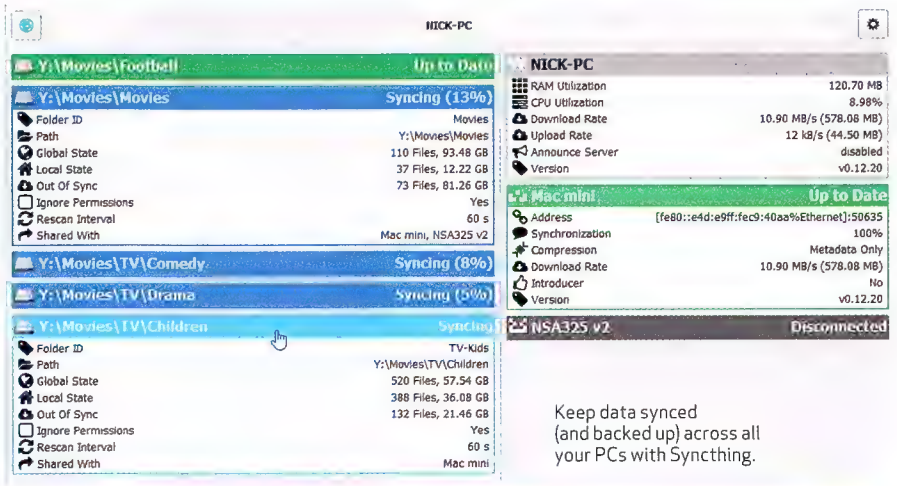
YOUR PERSONAL CLOUD

If you'd like to store files centrally (creating an additional backup of your files in the process), without relying on a third party, then set up your own using a spare PC or network hard drive as the file server.

Some network drives come with their own proprietary cloud systems – My Cloud from Western Digital, for example – but we recommend choosing something open source and more widely supported – OwnCloud (**owncloud.org**), which works across a variety of platforms. The server part can be installed to many network drives – including Zyxel and Synology (the latter via **synocommunity.com**) – as well as Linux-powered PCs, including the Raspberry Pi 2, if you're looking for a low-cost solution. You then download and install the desktop and mobile clients on Windows, Mac, Linux, Android, iOS and other supported platforms, to allow you to both sync



Worried about sensitive data? Viivo adds more encryption.



Keep data synced (and backed up) across all your PCs with Syncthing.

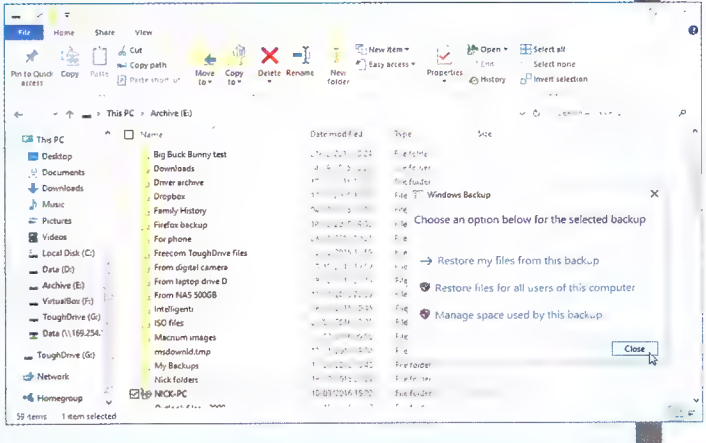
Protect your backups

Nothing lasts forever – and the same is true of backups.

Optical discs don't last a lifetime, while hard drives wear out, and cloud storage can disappear without warning. That's why backing up to multiple locations is essential, but it doesn't stop there. You should take additional steps to protect your data from physical degradation.

Check with the maker of your drive for a monitoring tool, such as Seagate's SeaTools (**www.seagate.com/seatools**), to keep an eye on your drives' health, giving you time to replace failing drives before they disappear with your data. If you want a network drive, choose a two-bay model, such as Synology's DiskStation 216+, and fill it with two identical drives in a RAID 1 setup. Data is mirrored on both drives, so if one fails, you can swap it out with a replacement without fear of data loss. Just remember a RAID array doesn't constitute two backups — if the enclosure fries (or gets stolen), you lose both drives. (As an aside, try the free DMDE data recovery tool from **www.dmde.com** if you need to recover data from NAS-formatted drives.)

Also watch the software you use. Some tools store your data in their own proprietary formats, so if the software stops working (perhaps after upgrading to an unsupported version of Windows), you lose access to your backup. Both Windows backup tools use their own format, as does Macrium, Backup Buddy,and Viivo (as part of protecting backups through encryption). So make sure one of your backup plans duplicate your files in their original format to ensure you have one easily recoverable version of your files.


Windows Backup
Choose an option below for the selected backup
Restore my files from this backup
Restore files for all users of this computer
Manage space used by this backup
Close

You can't recover files directly from Windows backups.

and access your files from anywhere. Think of OwnCloud as being your own personal cloud storage system – you're not tied to any third parties, there are no fees, and your cloud can be restricted to your local network or opened up for access over the internet. It works with multiple users, too.

Some initial configuration is required, but everything's point-and-click, with a useful manual on hand to steer you in the right direction. When asked to set up your initial account, be sure to click 'Storage & database' to select the 'MySQL' option, rather than the default 'SQLite' one. This will dramatically speed up the server's performance when it comes to syncing large batches of files.

RESTORING FROM BACKUPS

Disaster has struck – you've lost data, so what next? Thanks to your backup plan, you should find you're able to restore the data you lost. If you've used 'File History', navigate to the folder with the missing data in File Explorer and click the 'History' button on the File tab.

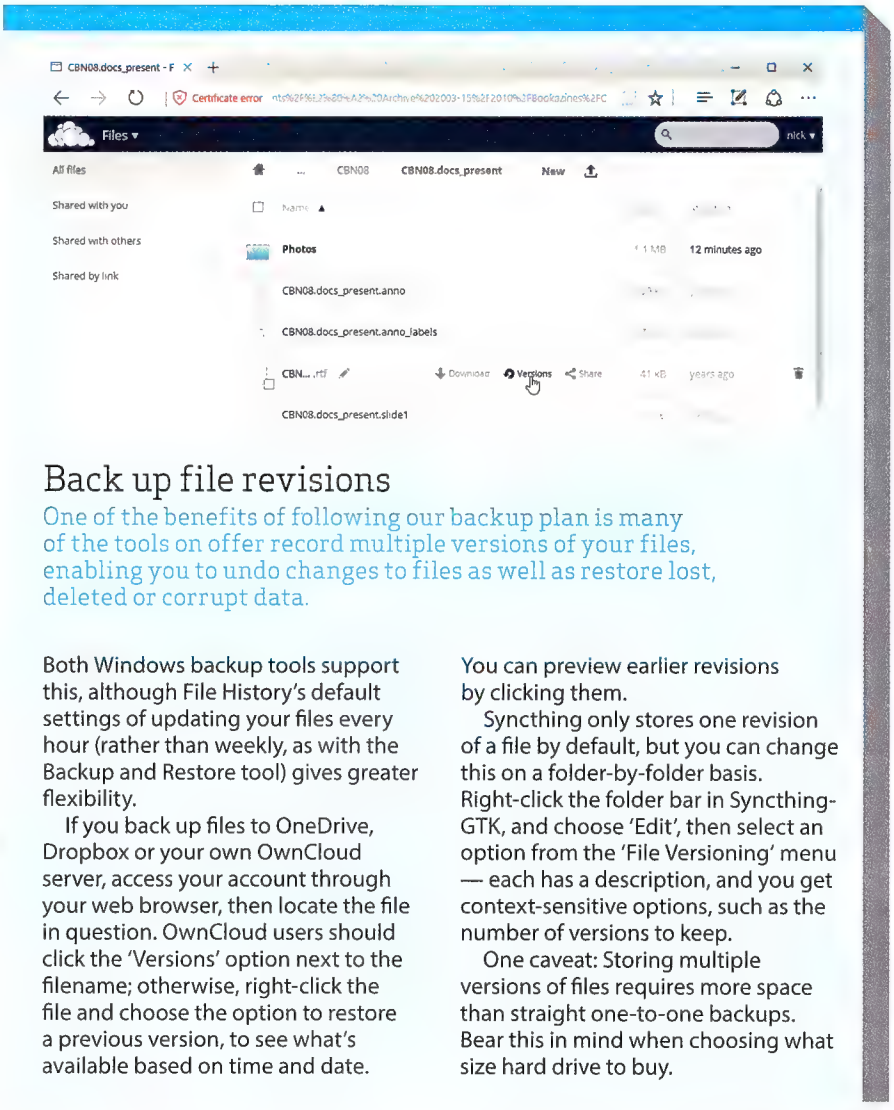
A window opens displaying all the backed-up files in that folder – double-click the missing file to preview it, then click the 'Settings' button and choose 'Restore' to save it to the current location, or 'Restore to' to save it elsewhere. If you're trying to recover an earlier version of a file, use the left and right buttons at the bottom of the page to navigate between available versions.

If you're recovering from 'Backup and Restore', browse to the drive or folder containing your backup, then double-click it and choose 'Restore my files from this backup'. Click 'Choose a different date' if you're looking for older versions of your files, or use the search and browse buttons to locate what you want to restore. You can restore them to their original location, or choose another – make sure you leave 'Restore the files to their original subfolders' ticked, before clicking 'Restore'.

Need to recover your entire PC? Macrium Reflect makes things straightforward. If you can boot into Windows, launch the app and switch to the 'Restore' tab; otherwise, boot from your rescue media. Select the backup you want to roll back to from the list given, or click 'Browse for an image file' to locate it manually. Select 'Restore Image' to restore the image, or choose 'Browse Image' to mount the image as a virtual drive, enabling you to browse it as a virtual drive in Windows itself – a good option for recovering individual files and folders from the backup. Tick 'Enable access to restricted folders' to allow you to recover data from user folders and other protected places.

Restoring files from the cloud isn't usually an issue, but if you need to restore a file you've deleted, then taking OneDrive as an example, log into your account through your browser. Click the main menu button and select 'Recycle bin' under your PC's entry.

Recovering data from OwnCloud is simple, too – when you reinstall the software and log in as your own user, you're prompted to choose which folder on your hard drive to store your OneDrive content on – once done, the folder syncs up with what's online, restoring any missing data, or you can log on through your browser to download individual files. ■



Back up file revisions

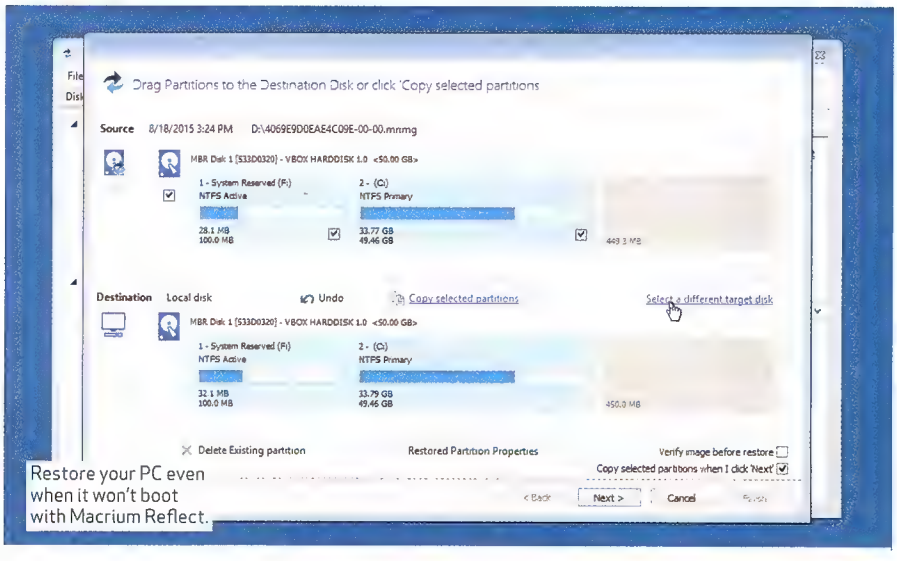
One of the benefits of following our backup plan is many of the tools on offer record multiple versions of your files, enabling you to undo changes to files as well as restore lost, deleted or corrupt data.

Both Windows backup tools support this, although File History's default settings of updating your files every hour (rather than weekly, as with the Backup and Restore tool) gives greater flexibility.

If you back up files to OneDrive, Dropbox or your own OwnCloud server, access your account through your web browser, then locate the file in question. OwnCloud users should click the 'Versions' option next to the filename; otherwise, right-click the file and choose the option to restore a previous version, to see what's available based on time and date. You can preview earlier revisions by clicking them.

Syncthing only stores one revision of a file by default, but you can change this on a folder-by-folder basis. Right-click the folder bar in Syncthing-GTK, and choose 'Edit', then select an option from the 'File Versioning' menu — each has a description, and you get context-sensitive options, such as the number of versions to keep.

One caveat: Storing multiple versions of files requires more space than straight one-to-one backups. Bear this in mind when choosing what size hard drive to buy.



Restore your PC even when it won't boot with Macrium Reflect.

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Build a kick-arse budget gaming PC

Advances in technology aren't limited to the high end, as Alan Dexter's complete gaming rig for around $1,000 proves.

For all too many of us, a truly top-end Intel X-series or even Ryzen system is well out of our price range. The hang-the-cost attitude has made for some incredible systems in the APC Labs, and this year's is no different, but what if cost is a factor? What if you can't afford to drop north of a grand on the cooling system alone? What if you want a machine that costs a fraction of what we dream up every year? What if you want a system that's as pleasing to your pocket as it is to use?

Our budget machine aims to offer just that: an impressive all-around experience for a fraction of what we normally look at in these pages. As the title suggests, that includes being able to handle games as well. Think of it as a console that you can actually do useful things on, as well as keeping yourself entertained. It is a PC, after all. And if you have a bit more cash to hand, you can use this system as a starting point for something that answers your needs much more specifically.

A quick note: When we built our budget machine a year ago, it had the subtext of being a powerful ally for VR as well, which you'll find lacking from the sales pitch of this year's budget machine. That is simply because VR isn't quite the driving force that it was. You can still play VR games on this setup, although if you're seriously into VR gaming, you may want to upgrade the graphics card.

PARTS LIST

PART		PRICE
CPU	PENTIUM G4620	$135
MOTHERBOARD	ASUS ROG STRIX B250I GAMING	$190
RAM	G.SKILL RIPJAWS V DDR4-2400 8GB (2 X 4GB)	$110
OS STORAGE	KINGSTON UV400 120GB	$75
DATA STORAGE	SEAGATE BARRACUDA 1TB	$65
GPU	EVGA GEFORCE GTX 1050 TI 4GB ACX 2.0	$260
CASE	PHANTEKS ENTHOO EVOLV ITX	$120
PSU	CORSAIR CX550	$95
TOTAL		$1,050

CPU — $135

Intel Pentium G4620

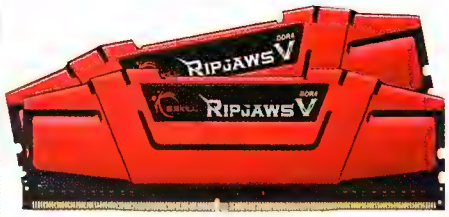
When we set out to build our budget machine last year, we turned to AMD for the brains of the operation. Given that we set ourselves an even tighter overall system price this year, you would be forgiven for thinking that AMD would be an obvious choice this time around, too. However, it's actually Intel that holds our budget hearts right now. Its Pentium brand has been getting us hot under the collar for a while, and this G4620 manages to check a surprising number of our essential boxes, given its lowly price tag.

There are actually plenty of choices at the bottom of the processor market, with older AMD Semprons vying with Intel Celerons, starting from as little as $49. Such chips lack anything approaching real oomph, though, with low core counts and low, low operating frequencies holding your general computing experience on the back foot. In fact, it isn't until you get closer to the $150 price point that the silicon begins to deliver where we need it.

This quad-thread Kaby Lake chip (two physical cores) boasts a healthy operating frequency of 3.7GHz, crams the Intel HD Graphics 630 into its silicon, has 3MB of L3 cache, and a thermal design power of 51W. Obviously, we have no interest in using the integrated graphics, because we've budgeted for a discrete graphics card from the off, but it's always good to have a backup, in case anything goes wrong.

An important factor when choosing this chip is the inherent upgrade path on offer, thanks to the fact that it uses the LGA1151 socket, which means that, at a later date, you could drop in a Core i5 or even a Core i7 for a huge speed boost. The fact that the Pentium G4620 supports up to 64GB of DDR4-2400 memory gives you another upgrade option, too.

For now, at least, the Pentium family gets the nod for any budget build. But it shouldn't be long before we see AMD APUs coupling Ryzen brains with Vega brawn to power a completely different kind of budget gaming machine, so watch this space.



RAM — $110

G.Skill RipJaws V DDR4-2400 8GB (2 x 4GB)

A year ago, you'd have been looking at 16GB of DDR4 for $120. Or to put it another way, memory has doubled in price in the last 12 months. As we're working to a tight budget, there's no wiggle room to allow for the increase, so we have to get by with less.

That said, we still recommend using named brands when buying memory, and Patriot is a company that has served us well for many years. These red and black sticks sit comfortably at 2,400MHz, with 15-15-15-35 timings. The fins of the cooler don't extend too high above the PCB, so they shouldn't interfere with your CPU cooling method of choice either.

OS STORAGE — $75

Kingston SSDNow UV400 120GB

If we had more cash, we'd populate one of the motherboard's M.2 slots, for some seriously fast storage. Unfortunately, M.2 drives still command a hefty premium, so your money is best spent on a standard SSD for the time being. If you're desperate for M.2, we recommend the 128GB Samsung SM961 for $130 on eBay.

As with memory pricing, it's been a turbulent 12 months for SSDs, and this year's budget build appears to offer the same capacity as last year – but at an increased cost. However, the devil's in the details, and last year's 120GB V300 is a slower beast compared to this year's 120GB UV400. Peak read and writes jump from the previous drive's 450MB/s to 550MB/s and 500MB/s, respectively, so you are getting a slightly better deal, depending on how you look at it.

MOTHERBOARD — $190

ASUS RoG Strix B250I Gaming

This mini-ITX motherboard is tiny, so it must be lacking on the feature front, right? Wrong. While it does only have one PCIe x16 slot, it manages to cram six USB 3.0 and four SATA ports into its tiny form, boast integrated Wi-Fi, and include support for not one but two M.2 drives. Oh, and it lights up like a Christmas tree as well. Impressive – very, very impressive.

The integrated SupremeFX audio is a cut above as well, residing on its own shielded area of the motherboard to maintain signal integrity, and using Nichicon audio capacitors. Throw in the three PWM fan headers, and you have a fully featured motherboard that just so happens to be absolutely tiny.

DATA STORAGE — $65

Seagate BarraCuda 1TB

SSDs are great for speedy access, but they lag behind spinning drives when it comes to capacity. And when you're talking about building a games machine, having somewhere to save your games is important. Especially when your main boot drive is quite small, like we have in this machine.

This 1TB BarraCuda boasts 64MB of cache, to help keep your data moving, and while the maximum sustained transfer rate of 210MB/s isn't going to trouble an SSD, you've got enough room on the OS drive for your most-used apps and games. As a bonus, this single-platter, twin-head drive is slightly thinner than standard hard drives, which could potentially help with airflow in a super-tight system.

GPU — $260

EVGA GeForce GTX 1050 Ti 4GB ACX 2.0

Nothing touches graphics cards when it comes to choice. Even when you hone in on a particular GPU, you'll find there are multiple cards available, often from the same company. The graphics card market is now so granular that a few extra dollars here and there can net you a slightly higher overclock, a quieter cooler or added bling in the form of pulsating LEDs. Whether you have $100 or $1,000, there's a graphics card out there for you.

Amazingly, if you're on a tight budget, there aren't too many GPUs worth considering: At the budget we've set aside for the graphics subsystem, this essentially comes down to a toss-up between the Nvidia GeForce GTX 1050 Ti and the AMD Radeon RX 560. This is a fairly straightforward win for Nvidia, because the 1050 Ti is a much stronger performer, and 4GB models are more readily available than their RX 560 siblings. AMD's Radeons seem to be suffering from renewed interest in cryptocurrency mining as well, making for limited stock pretty much everywhere.

The EVGA card we grabbed boasts a slight overclock over Nvidia's base specification – with a base clock of 1,354MHz against Nvidia's base specification of 1,290MHz. These days, the base clock is actually less important than the boost, because GPU Boost 2.0 automatically overclocks the card, dependent on temperature – but, again, this overclock extends there as well, with a boost clock of 1,468MHz against the suggested 1,392MHz. The single fan cooler does a great job of keeping those 768 CUDA cores chilled without making a lot of noise, as well.

The other benefits of this Pascal card are its short form factor and the fact that it doesn't need any additional power connectors, drawing all the juice it needs from the PCIe slot. Nvidia recommends you have at least a 300W PSU for any system using this card, which means we have power to spare in our rig.

CASE — $120

Phanteks Enthoo Evolv ITX

If you're building a budget PC, you've probably resigned yourself to the idea that you won't be able to afford a decent-looking chassis. The Enthoo Evolv ITX proves that this doesn't have to be the case [*Haw haw! — Ed*]. This sleek white system is absolutely gorgeous, yet will only set you back $120. The fact that we've used this chassis in far more expensive builds speaks volumes, really.

It's a breeze to build in, too, with Phanteks' eye for detail showing through in everything from build quality to material selection to fan placement. That single large 200mm fan behind the front panel keeps your components cool, and due to its size, it doesn't make any noticeable noise when doing so. Dust filters help keep your build clean, while Velcro straps keep your system airflow-friendly. And did we mention that it looks amazing as well?

PSU — $95

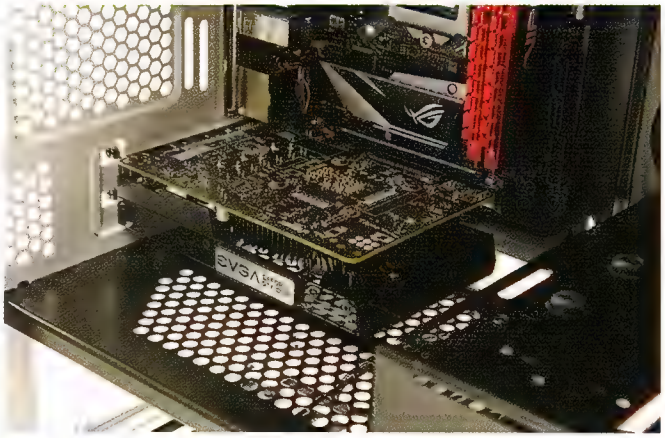
Corsair CX550

Go with known brands — especially when it comes to memory and power supplies. You may miss out on some real bargains by doing so, but what you will have on your side is consistency, and the reassurance that a big name brings to your build. And the warranty. Don't forget the warranty.

The CX550 is potentially overkill for this build, because we've ended up drawing just under 200W. However, having a beefier power supply makes upgrading easier — affording plenty of room for more hungry CPUs, GPUs, and more storage. Note that this unit arrived a little late for our photography, so we used an RM650 for that, but swapped it out for the CX550 for actual testing.

$1,000 PC build, ahoy!

A step-by-step guide to building your own super-budget, arse-kicking machine.



1 TAKE THE FIRST STEP

You know the one thing we almost always forget to do every time we build a system? Install the rear I/O plate. After you've got all your shiny new hardware unboxed, prepped somewhere sensible to build your new rig (no woolen socks, or fluffy carpets), and stripped your case of any unnecessary hard drive cages and accessory boxes, install your mobo rear I/O shield. It helps reduce potential static discharge from your cables and peripherals, and also reduces the amount of dust entering your system. Once that's done, line up your motherboard with the pre-installed stand-offs, and secure it with the correct screws (often included in your case's accessory box/bag). It's worth noting that, if you have an air tower cooler that requires a backplate, it's wise to install the backplate before securing the motherboard inside the chassis.

2 THE BEAUTY OF AN ITX BUILD

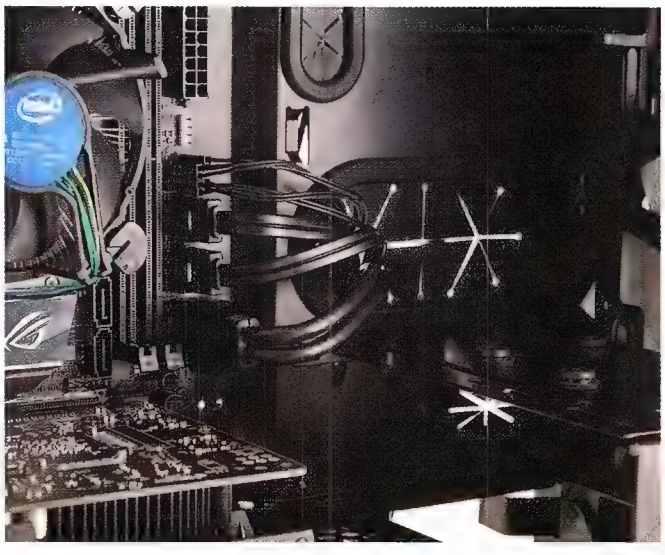
After your mobo is safe and secure, you can start installing the majority of your new hardware. We suggest the processor first. For Intel's LGA socket, lift the retention arm up and out, until the bracket can be lifted up. Gently place your new processor in, with the golden triangle on the corner of the CPU matching the triangle on the socket, then plop it into place. Don't force it, or try to push it down; simply place it, then give it a very slight wiggle with your finger, to make sure it's secure. Bring the bracket back down, secure it under the bottom torque screw, and bring the retention arm back down as well. The protective cover will pop off and you're good to go. Next, you can install the memory — be sure to line up the notch at the bottom of each stick of DDR4 with the notch on the slot, then push it securely into place at both ends, until you hear a satisfying click. For the GPU, remove the screws securing the PCIe brackets in place, then slot your new graphics card into the single PCIe slot, before resecuring with the screws.

3 FAN-TASTIC

"You could spend much less on a case!" We hear you, but the Evolv ITX is a fantastic small form factor case to build in. And this is one reason why: It comes with an impressively large 200mm single fan intake at the front. Plugging this behemoth into your motherboard provides plenty of air to keep your system well fed, and it comes with a pretty substantial dust filter, too. And if you really want, you could take it out and use a 240mm AIO here instead. Speaking of fans, once you've got this far, you're going to want to install your CPU heatsink. By default, the Pentium G4620 comes with a stock Intel cooler, with pre-applied thermal paste. Simply align the fan pins with the holes in the motherboard, click the fan into place and lock the pins by turning them to the left.

4 STICKING IT TO THE STORAGE

Next up is storage. By default, the Evolv ITX comes with a single 2.5-inch SSD mount in the rear. Simply slide the tray up off its rubber mounts, slot in your SSD, and secure it with the included screws (check your accessory bag). Then slide it back into place on those rubber grommets. You'll spot the hard drive caddies for our 3.5-inch drive located below this, hidden by the PSU cover. Simply pull the two included trays out, unlock the securing latches on each side of a tray, line up your hard drive, and bring the two securing latches back into place. Then it's simply a case of sliding the caddy back into the 3.5-inch drive cage. Make sure that the connection ports for the SSD are facing down, and your 3.5-inch drive ports are facing toward the rear panel.

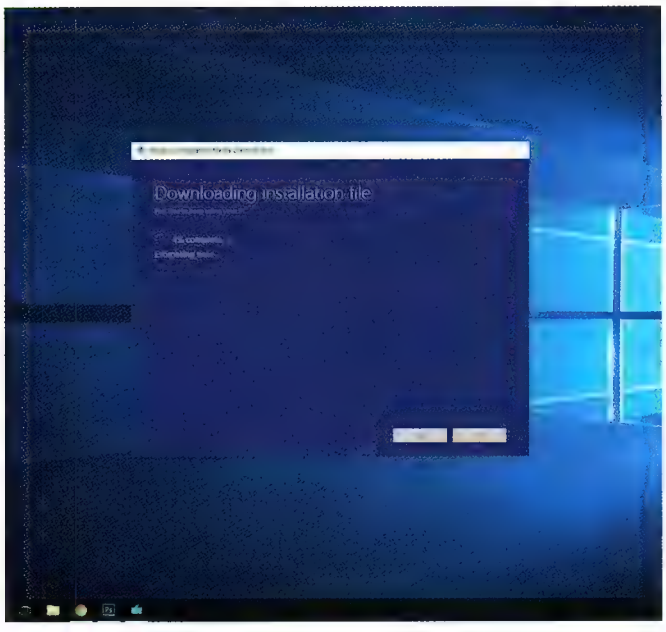


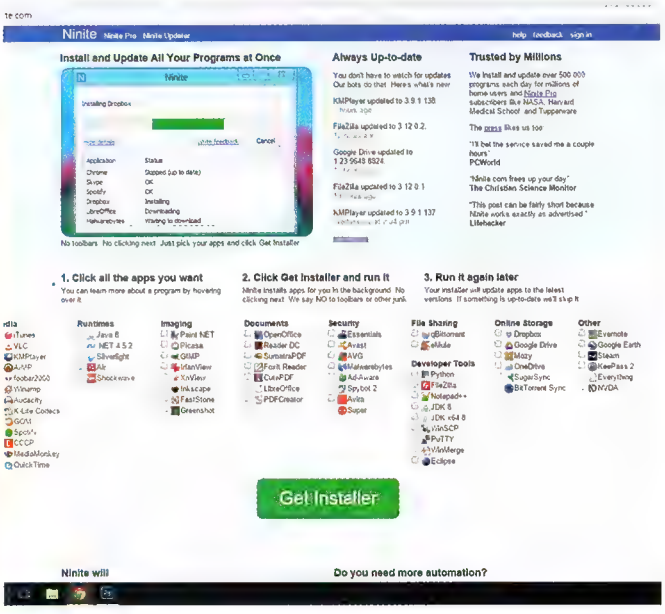
5 FRONT PANEL PROBLEMS

At last we get to the first ITX niggle: front panel connectors. Things get pretty tight when you start installing cables like this. You can install the front panel audio connector before you insert the GPU without much worry — most cards have a cut-out to allow you to thread it under for just such a situation as this. However, front power, LEDs and HDD indicators are trickier. The Strix B250i comes with details on the motherboard about which connector needs installing where, but you may find you need to remove the RAM to install them a little more easily. One thing to note: the plus and minus for the LEDs need to be oriented the correct way around (as indicated in the motherboard manual, and on the board), otherwise they don't work.

6 A TALE OF CABLES AND COVFEFE

Now it's time to wrap up your build. Thread through your 24-pin power through the side rubber grommet, and the eight-pin power through the top grommet, and you're good to go. The GTX 1050 Ti we've used here relies solely on power drawn from the PCIe slot itself, with no additional PCIe power needed. Finally, use two SATA powers for both the SSD and the HDD, and you're sorted. After that, there are a few upgrade options you could go for. As seen here, the Evolv ITX supports 240mm AIOs in the roof, and on top of that, given the PSU, you could also upgrade to something along the lines of a GTX 1060 or 1070 with relative ease. Couple a 1070 with a Core i5 processor, for instance, and this little ITX build will be a quick, quiet, powerful 1440p gaming machine.




Ninite
Install and Update All Your Programs at Once
Always Up-to-date
Trusted by Millions
1. Click all the apps you want
2. Click Get Installer and run it
3. Run it again later
Get Installer
Ninite will
Do you need more automation?

3 OS OF CHOICE

With all the physical work done, it's time to install Windows. To do this, grab yourself an 8GB USB stick and, on another system, head to **bit.ly/Win10MediaTool**, and download the Media Creation Tool from Microsoft. Run the program, select 'Create New Installation Media' (make sure it's the x64 version), select your 8GB USB stick (bear in mind that it will be formatted) and let Windows complete the job. You then need to plug the USB stick into the back of your new system, power on, mash 'Delete' and change the boot order in BIOS so that 'UEFI:[USB STICK NAME]' is at the top. Hit F10, save and exit, then install Windows on to your brand spanking new SSD, entering your Windows 10 key when prompted.

4 MASS INSTALLATION

You'll now want to run through some initial setup procedures. In this case, head to ASUS's website, find your specific motherboard model's page, click 'Support', then 'Driver & Tools', select your OS (in our case, Windows 10 64-bit) and download 'Intel Chipset Driver', 'Management Engine Interface' and 'Realtek Audio Driver', and any other software you might need. Install the chipset driver before anything else. Then head to **www.nvidia.com** and download GeForce Experience. Once installed, it should prompt you to download and install the latest drivers for the GTX 1050 Ti. One last thing: we suggest going to **ninite.com**, and grabbing all of your day-to-day programs' installers.

BENCHMARK RESULTS

	APC LABS TEST PC	THIS PC
CINEBENCH R15 MULTI-THREAD (INDEX)	507	375 (-26%)
CINEBENCH R15 SINGLE-THREAD (INDEX)	90	149 (66%)
TECHARP X264 (AVG FPS)	11.98	8.81 (-26%)
CRYSTALDISK QD32 SEQUENTIAL READ (MB/S)	511	550 (8%)
CRYSTALDISK QD32 SEQUENTIAL WRITE (MB/S)	105	495 (371%)
CRYSTALDISK RANDOM 4K READ (MB/S)	21.94	20.90 (-5%)
CRYSTALDISK RANDOM 4K WRITE (MB/S)	83.66	65.92 (-21%)
PCMARK 8 CREATIVE ACCELERATED (INDEX)	5,380	5,213 (-3%)
3DMARK FIRE STRIKE (INDEX)	7,835	6,270 (-20%)
RISE OF THE TOMB RAIDER (INDEX)	35	23 (-34%)
FAR CRY PRIMAL (AVG FPS)	53	40 (-25%)
THE DIVISION (AVG FPS)	57	36 (-37%)
STEAM VR PERFORMANCE TEST (INDEX)	6.6	3.3 (-50%)

Our Labs Test PC here is the $1,300 system we built way back in our October issue last year, featuring an AMD FX-8320E eight-core processor, AMD Radeon RX 480, 16GB of Corsair Vengeance Pro DDR3, and a Kingston SSDNow V3 120GB SSD. All games tested at 1080p at the highest graphical profile, with AA ramped up.

1 The RGB lighting included with the ASUS Strix B250i was a nice surprise — we didn't even know about it until powering it on.

2 The Phanteks Evolv ITX can support a full-sized GPU; the bracket to the right is designed with liquid cooling in mind.

3 The Pentium G4620 is still the best budget offering — at least until AMD drops its Ryzen 3 series processors on us.

4 In hindsight, saving some cash on the motherboard and plumping for a GTX 1060 instead may have been a better option.

Is $1,000 enough?

WHAT AN ODD TIME TO BE A GAMING ENTHUSIAST!

With both Project Scorpio and the PS4 Pro each promising 4K gaming at price points lower than $700, the argument for a budget gaming PC has come under quite a lot of scrutiny. After all, even this machine – specced at just a grand – is only aimed at 1080p and no more. So why invest in it as a platform if you're keen on gaming?

The answer isn't straightforward. First and foremost is the level of customisation available to those on the PC platform. There are a lot of similarities that can be drawn between a Mac and a console. They're both very much locked down into specific settings and applications, limiting what you can do on them, and both are designed not to stress the hardware. That said, as time has passed and technology has advanced, there's now little difference between consoles and PCs from an architectural standpoint. Both use X86 as a coding platform, and both have hardware based off the same SKUs. In fact, the newly announced Xbox One X has a slightly higher clocked RX 480 as the base of its graphics rendering chip.

If that's the case, how can they achieve that 4K 30fps "sweet spot" that Sony and Microsoft's marketeers clamor for? Again, it's back to that Mac comparison—everything is locked down, and in the console's case, graphical settings are gimped and optimized to their extremities to achieve that goal.

Turn to the PC, on the other hand, and there's no limit to what you can do with the platform. Not only when it comes to adjusting graphics to your particular preference, and smashing frame rates well above that console archetype in the process, but also regarding how you use it. Versatility is key. Whether that's playing flight simulators, RTS games, first-person shooters or RPGs; using controllers, joysticks, HOTAS setups or steering wheels; at 1080p, 1440p, 4K, 3,440 x 1,440, or with multiple screens; and with backward compatibility and a roster of exclusives more far-reaching than any list ever provided by any of those sub-par living-room boxes – it's not hard to see why the PC as a platform is superior.

All that aside, it all comes back to that value proposition. How much is all that versatility worth? In our case, with this build, potentially less than you think. Of course, the GTX 1050 Ti isn't the powerhouse of gaming we would like it to be; although you can successfully achieve 60fps in most 1080p titles with a bit of loving and some tweaking to AA and more, in our testing suite, we failed to hit the mark. And the Pentium G4620 is a fantastic budget offering, but if you're after rendering or doing any form of extracurricular gaming activities, it falls flat.

What our $1,050 machine does show, however, is how much extra you get by investing just a touch more cash. We're constantly harping on about what the sweet spot is for price to performance – in our case, last October's budget VR machine wipes the floor with this month's build. In fact, if you were to go a bit higher, and aim for a budget of $1,300, you could make yourself a fairly sound 1440p gaming rig for just a little extra dough. ■

how to

» QUICK TIPS

Experts solve your computing problems

APC and its readers can be one giant helpdesk. If you have a technical problem, chances are one of us can solve it.

WINDOWS

RESTORE MISSING TILES TO START MENU

After Microsoft support recently fixed some issues with my PC, they were unable to tell me where many of my Start menu tiles had gone. Can you please help me restore them?
Charles Church

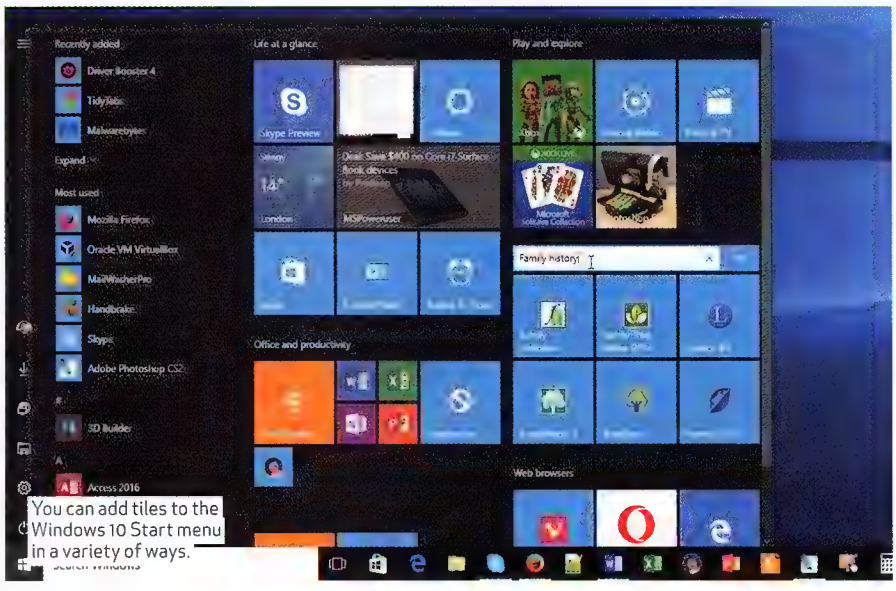
Start menu tiles can be added quickly enough from a variety of locations on your computer. This step-by-step guide will help you both restore and manage your tiles into groups...

1 Click the Cortana or Search Windows box next to the Start menu. Start typing the name of the app you're looking for – if it shows up in the list, right-click its entry and choose 'Pin to Start'. This works for both desktop and store apps.

2 Click the Start button and scroll through the list of installed applications on the left. When you find the one you're looking for (if it's behind a folder entry, click that entry to reveal its contents), again right-click it and choose 'Pin to Start'.

3 If you have any portable apps sitting on your hard drive, or apps that haven't placed a shortcut in the 'All Apps' section of the Start menu, simply browse to the relevant folder, right-click the program's executable file and then select 'Pin to Start'.

4 Once you've added all the tiles you want, click the Start button and manage them by drag and drop – group related items together, then click the = bar above them to enter a suitably descriptive title.
Nick Odantzis



MAC

CAN I IMPROVE MY MAC'S GRAPHICS?

I've seen information about external GPUs for laptops. Would I be able to use one with my Retina 5K iMac (Late 2014) to enhance gaming?
Pete Pagan

You can hook up an external GPU to a Mac's Thunderbolt port to deliver improved graphics performance. One supplier of the necessary kit is Bizon, with its latest BizonBOX 3. This is expensive, particularly as you'll have to ship it to Australia which costs well over $100 as it is, but it can be customised to provide the graphics card which you want. However, according to Bizon's own tests, your iMac could only use this as a CUDA accelerator (CUDA is a graphics API used by some apps), so you're unlikely to see a noticeable general graphics boost in OS X. Bear in mind we haven't tried out this kit ourselves. Also, Intel only officially supports eGPUs as of Thunderbolt 3, so we wouldn't expect support from Apple for any issues you might run into between Mac apps and Bizon's kit, which is designed for older Thunderbolt specs. In Windows, you should get worthwhile acceleration, particularly in games. However, right now, no one is sure how the eGPU market will develop for Macs.
Howard Oakley

WINDOWS

DISPLAY RESOLUTION PROBLEMS

My dual-boot system is exhibiting strange behaviour — the icons in Windows 7 are about a quarter of the size they are in Windows 10. How do I make them smaller in Windows 10?
Jamie Marshall

This problem suggests the correct display drivers haven't been installed for Jamie's graphics card. He first needs to identify its model in Windows 7 via Device Manager, then source the latest available driver for Windows 10. This should be easy if the graphics chip is identified as Nvidia or Intel – visit either **www.nvidia.com** or **downloadcenter.intel.com** respectively. If it's an AMD chipset, it's likely the card is an older one, not supported by Windows 10 – go to **bit.ly/ati-legacy** and download the Software Suite to obtain a Windows 8.1 driver that should still work in Windows 10. If this fails, it's time for an upgrade.
Mayank Sharma

WINDOWS

WINDOWS KEEPS LOCKING ME OUT

Over the past few weeks, Windows 10 keeps locking me out of my account every three to four days. I've been forced to use a password recovery tool

to get past this. I then set a new password for my account, but it doesn't seem to stick. Can you help please?
John Wallis

John was logging into Windows using a local user account – we suggested switching to logging in using his Microsoft Account then, if he wished, switching back to the local user account to see if that resolved the problem. If the problem persists, it may indicate a corrupt user account, which would involve creating a new user account, then migrating files and settings across from your old account using a tool like Transwiz (**www.forensit.com/move-computer.html**). In the end, John chose to stick with logging in through a Microsoft Account.
Cat Ellis

MAC

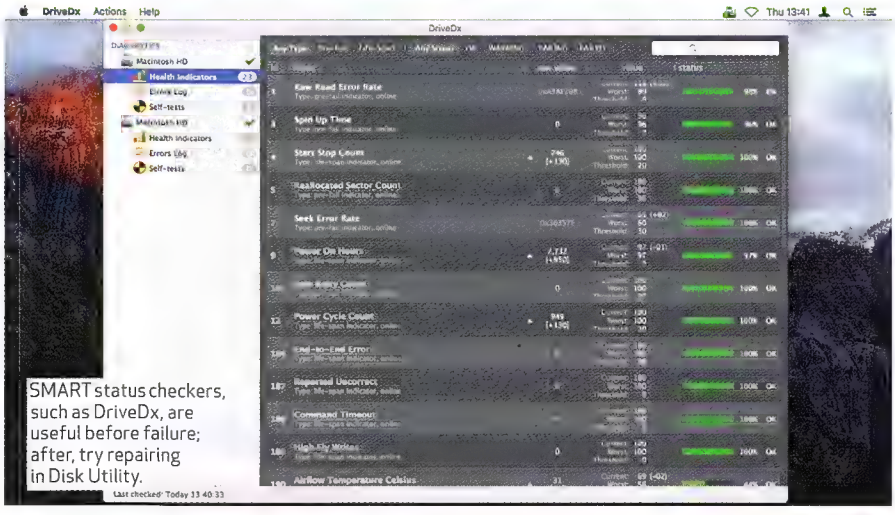
EXTERNAL DRIVE TROUBLE

When my iMac crashed today, its logs were full of messages about "Failed to composite image for descriptor" errors prior to forcing its shutdown. I also saw some repeated errors from the kernel about a 'disk1s2: I/O error'. I've only recently upgraded to El Capitan: does this indicate an incompatibility with it?
Mark Syder

The upgrade process may have brought on your problem, but the more critical and worrying of those error messages are those relating to disk1s2, which is likely to be an external hard drive. Input/output errors like this are normally the result of a serious issue with a drive, possibly even complete drive failure or a defective electrical connection. Ensure both ends of the drive's connecting cable are fully inserted into its ports, and that the cable is a good one. Check the drive using Disk Utility first, and perform any necessary repairs. If that reports a SMART status error or other hardware failure that can't be fixed, eject the drive and shut it down immediately. Several utilities, such as the excellent DriveDx, can provide you with more details about SMART warnings, errors and other faults, but once your drive has failed, there is little point in holding a post mortem. If the drive hasn't died, it might still be recoverable. When you have a replacement, you might be able to salvage the old drive's contents and copy them over to your new one. Unfortunately, sudden drive failures can still be the cause of crashes, although OS X is getting more resilient to such hardware issues.
Howard Oakley

Nvidia cards are supported for much longer than AMD ones.

"Several utilities, such as the excellent DriveDx, can provide you with more details about SMART warnings, errors and other faults, but once your drive has failed, there is little point in holding a post mortem."



SMART status checkers, such as DriveDx, are useful before failure; after, try repairing in Disk Utility.

User Profile Transfer Wizard
Welcome to the User Profile Transfer Wizard
This wizard helps you transfer data and settings between different computers.
What do you want to do?
I want to transfer data to another computer.
I have data I want to transfer to this computer.
FORENSIT
< Back
Next >
Cancel

Corrupt Windows user account? Transfer your files and settings to a new one.

Purchase a NAS drive for the ultimate private network storage.

STORAGE
SET UP PERSONAL CLOUD

I'm interested in setting up my own personal cloud and have been looking at the Synology DS215J. Can you recommend this (or another) unit and assist me in getting its personal cloud to work so I'm free of the constraints of a third-party service like iCloud?
Ray Dinning

We are happy to recommend the DS215J as a good entry-level drive for those looking for a bit more than just basic network drive capabilities. Ray duly purchased and installed it, but wanted to know how to use it to keep files in sync between two desktops and laptops. We pointed him towards Synology's own Cloud Station tool – you need to set this up on the Synology through its web interface, then download and install the Cloud Station Drive on each PC.

A step-by-step guide is provided at **bit.ly/cloudstn-setup**. We recommend choosing the 'two-way sync' option to keep a folder in perfect sync between computers (and store a central copy of those files on the drive itself).
Alex Cole

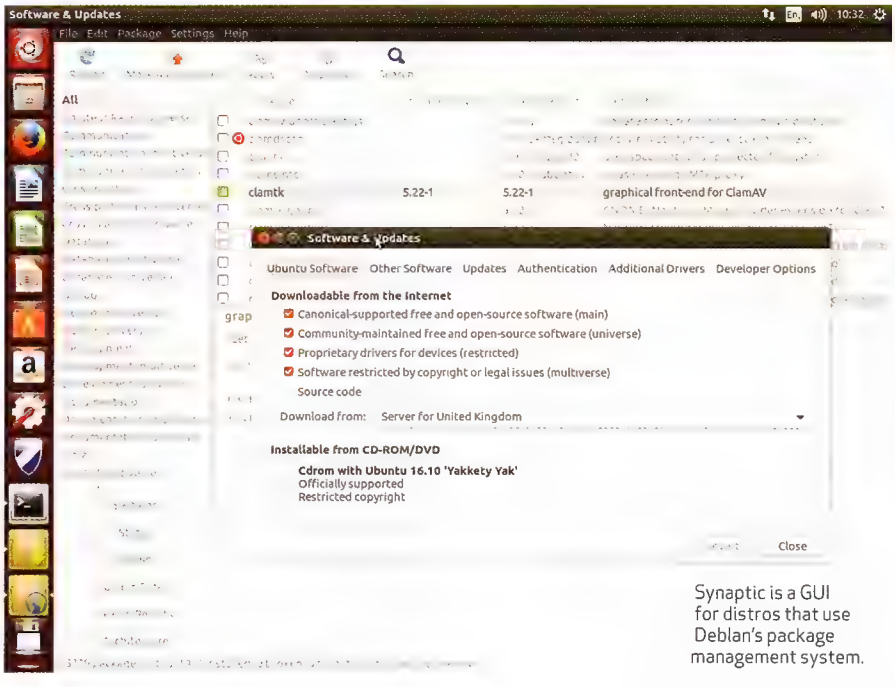
LINUX
UBUNTU DIMINISHED?

My everyday system is Ubuntu 16:04, which has moved through the upgrades very nicely over the years. Until I upgraded to Ubuntu 16.10 when I got messages that some programs hadn't been restored. This has never happened in the past. I need to use rgbpaint, which is no longer available and I can't view videos from my car dash cam as I cannot load VLC. It would appear that this new upgrade is a cut-down version of the old system. I can no longer search the long lists of programs that were available; this new system only gives one a small choice of applications. As the main user this is all I can see. There doesn't appear to be a way to look for old programs. I reloaded one of my backups — but the system didn't revert back as the wallpaper, and system settings were all the new version. I also noticed it didn't restore any of my local folders of old emails in Thunderbird.
Bill

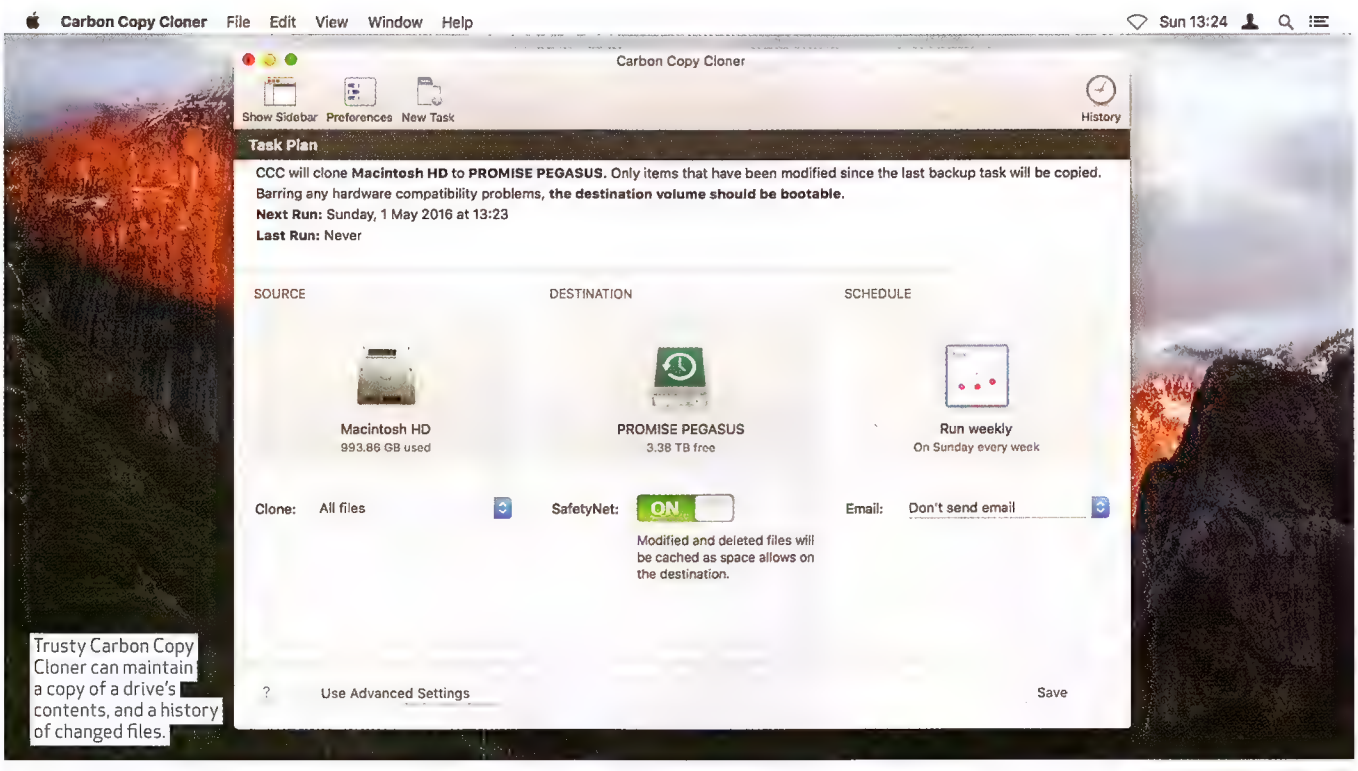
The Ubuntu Software does seem to be a somewhat limited attempt at a package manager, taking the KISS ('keep it simple, stupid') approach rather too far in our opinion. We recommend you use it to install Synaptic, which is a more useful package manager GUI. With Synaptic, you can manage software repos and search for and install packages. It gives you almost as much control as the command-line tools but with a friendly interface. VLC should be available, it's more a case of it not showing up for whatever reason, but Synaptic will find it. It may be that you need to enable the multiverse and/or universe section of the repos, which Ubuntu doesn't use by default. That is simply a matter of ticking a couple of boxes in Synaptic's settings.

Packages are dropped from time to time. Managing a distro involves making choices about software that is no longer actively maintained, especially software that uses obsolete or unsupported libraries (rgbpaint

"Bill didn't say which backup software he used, but it sounds like he backed up the system but not the /home directory. That would explain why none of his information or settings were included."


Software & Updates
File Edit Package Settings Help
All
clamtk 5.22-1 5.22-1 graphical front-end for ClamAV
Software & Updates
Ubuntu Software Other Software Updates Authentication Additional Drivers Developer Options
Downloadable from the internet
Canonical-supported free and open-source software (main)
Community-maintained free and open-source software (universe)
Proprietary drivers for devices (restricted)
Software restricted by copyright or legal issues (multiverse)
Source code
Download from: Server for United Kingdom
Installable from CD-ROM/DVD
Cdrom with Ubuntu 16.10 'Yakkety Yak'
Officially supported
Restricted copyright
Close

Synaptic is a GUI for distros that use Deblan's package management system.


Carbon Copy Cloner File Edit View Window Help
Sun 13:24
Carbon Copy Cloner
Show Sidebar
Preferences
New Task
History
Task Plan
CCC will clone Macintosh HD to PROMISE PEGASUS. Only items that have been modified since the last backup task will be copied.
Barring any hardware compatibility problems, the destination volume should be bootable.
Next Run: Sunday, 1 May 2016 at 13:23
Last Run: Never
SOURCE
DESTINATION
SCHEDULE
Macintosh HD
993.86 GB used
PROMISE PEGASUS
3.38 TB free
Run weekly
On Sunday every week
Clone: All files
SafetyNet: ON
Modified and deleted files will be cached as space allows on the destination.
Email: Don't send email
Use Advanced Settings
Save
Trusty Carbon Copy Cloner can maintain a copy of a drive's contents, and a history of changed files.

uses GTK 2). When the software becomes incompatible with the rest of the system, or the maintenance burden becomes too high, software may be dropped, but there's usually a more up-to-date alternative you can use. In many cases, it is possible to find packages of the older software in a different repo or a PPA. A web search with the program name, distro and the word "install" should yield pointers.

Bill didn't say which backup software he used, but it sounds like he backed up the system but not the /home directory. That would explain why none of his information or settings were included. We would recommend using a separate partition for /home when installing a distro. That way, upgrades will never touch your personal data as that filesystem will not be touched by the installer.

APC team

STORAGE
HOW DO I BACK UP A 3TB ITUNES LIBRARY?

I keep my iTunes library on a 6TB WD My Book Thunderbolt Duo, which is set up as a mirrored RAID array that gives me 3TB of actual storage capacity, but the drive is running low on free space. I also have a LaCie 2big Thunderbolt drive with two 3TB disks set up as a RAID mirror. How should I use these to ensure my library is properly backed up?

John Broomfield

To implement a solution, you need a strategy that meets your need to be able to restore the contents of a failed drive containing your whole library.

> "Frequency of backups, an important factor in determining required capacity, depends on how often files change."

If the library's contents were bought from the iTunes Store, they could all be downloaded again; devoting expensive storage to backups may not be a good use of those resources. However, redownloading 3TB of tracks would normally take a very long time. Frequency of backups, an important factor in determining required capacity, depends on how often files change. Most contents in an iTunes library are likely to be unchanged over time. One potentially efficient solution would be to keep your current drives, each operating as a 6TB volume, and use Carbon Copy Cloner to maintain a backup set from one drive to the other. This provides 6TB, so your library can grow, but it's prone to data loss if one disk in each array fails at the same time (compared to up to three in your current, less capacious arrangement). Unless the library changes daily, you may only have to run that backup routine every few days or so.

Howard Oakley

HARDWARE
WINDOWS 10 WON'T RECOGNISE DVD DRIVE

I had no problems upgrading my HP laptop to Windows 10, but since upgrading my three work PCs, we've discovered all three DVD drives won't recognise any discs. Two are generic, one is an LG model. Can you shed any light?

Paul Younger

We went through everything to try to resolve this problem – the drives all continued to appear in the BIOS, but refused to show up in Windows, either in Device Manager or in File Explorer.

However, when Paul's colleague Ron plugged in an external DVD drive, that worked perfectly. We suspect the issue might be with the motherboard – a Gigabyte GA-MA790FXT-UD5P board with AMD 790FX chipset. We checked online and found it to be seven years old, and no longer supported, so Windows 10 chipset drivers weren't available.

Rather than continue to troubleshoot the problem, our next suggestion was to take a drive image, then try a clean installation of Windows to see what effect that had before restoring the current setup.

Both Paul and Ron have since decided to invest in new Windows 10-friendly computers.

Alex Cox

Get more control over audio volume in Windows

Getting to know the volume controls of Windows can make listening to music, playing games and watching movies far more enjoyable, says Matt Hanson.

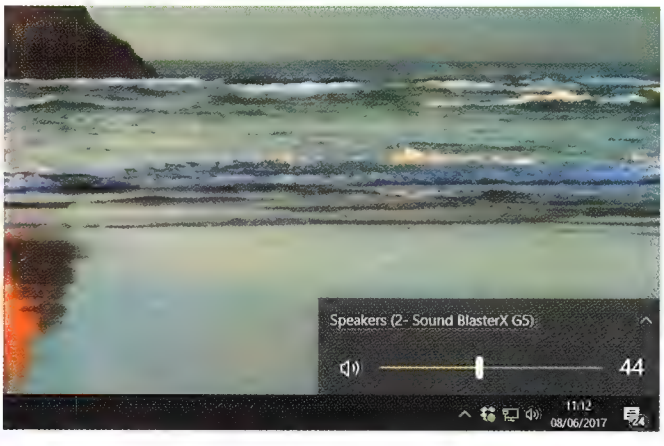
Most of us use our Windows PCs to enjoy media on, which is why complete mastery of the volume controls in Windows is a must. This isn't just about turning the volume up and down – Windows features a number of in-depth tools that can enable you tweak your sound settings so you're getting the best possible sound quality – without deafening yourself or waking up your neighbours.

These tools let you change the devices that will play back your media (handy if you have speakers and headphones and want to switch between the two), as well as alter the volume for different programs – so no matter what you're doing on your computer, you'll get the best possible audio experience.

In this guide, we'll take you through all the handy tools, features and shortcuts you can use to get pitch-perfect playback in Windows.

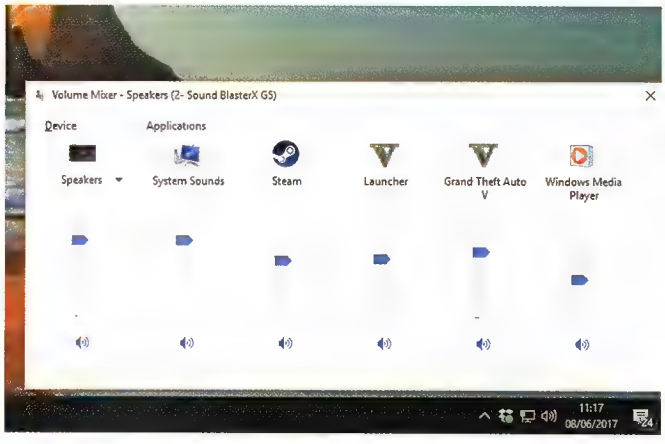
Step-by-step

Master the volume controls in Windows



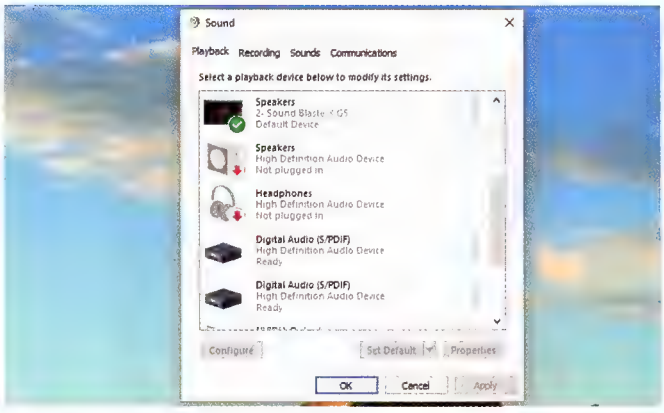
1 QUICK VOLUME CONTROL

The quickest way to change the sound level is to click the Volume icon in the Taskbar. You'll see a slider that lets you adjust the volume for your default sound device. Drag the slider left to turn down the volume, or right to increase it. Many laptops and keyboards also offer volume control shortcuts. This usually involves pressing the Function key, plus another key, such as F12.



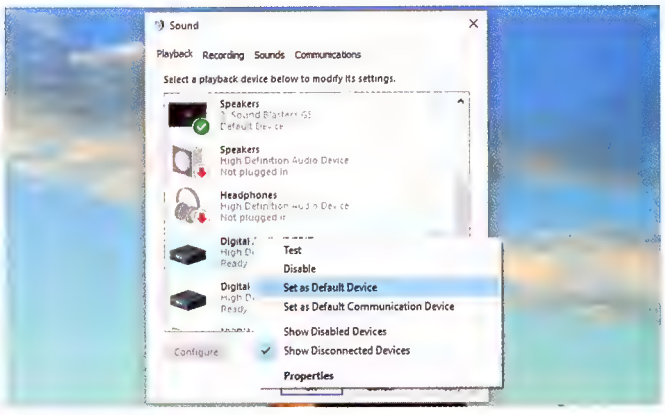
2 USE THE VOLUME MIXER

Right-click the Volume icon in the Taskbar and select 'Open Volume Mixer'. This tool allows you to change the volume for each open program, including Windows. Each app will have a vertical volume that you can slide up and down to control its sound level. On the far left of the window is the Device volume. This sets the maximum volume — no application will be able to exceed this.



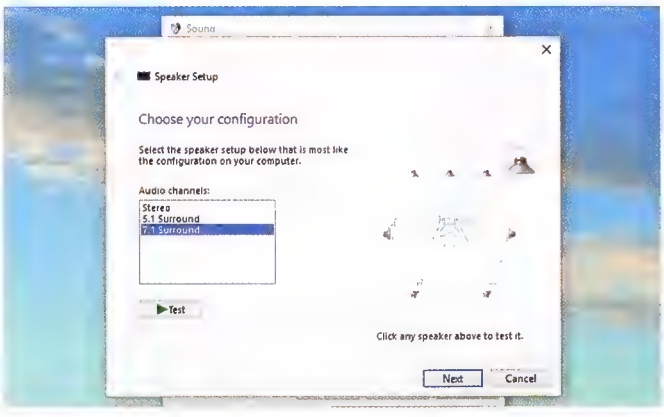
3 SET PLAYBACK DEVICES

Right-click the Taskbar's volume icon and select 'Playback devices', to see all the playback devices on your PC. For laptops and tablets, you'll probably only see one — unless you have a headset installed — while desktops may show speakers in connected monitors, too. You'll want to make sure that your PC uses the correct playback device for optimum sound quality.



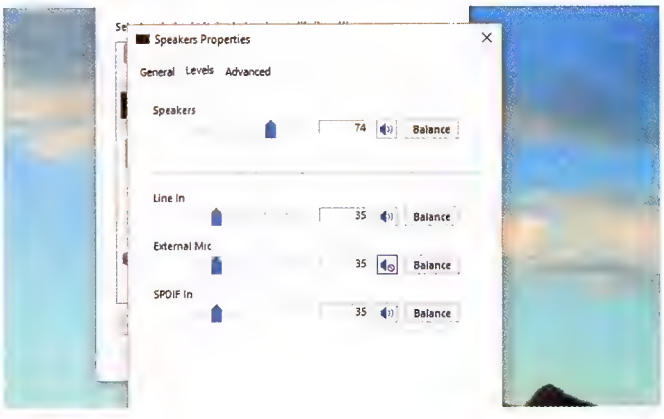
4 CHANGE THE DEFAULT PLAYBACK DEVICE

If the wrong playback device is selected as your default, you can use this window to change it. Make sure the device is working by right-clicking it, then select Test. You should hear a test sound. Each speaker will be tested, so this is a good chance to make sure they all work. Once you've tested the device, you can set it to be the default by right-clicking it and selecting 'Set default device'.



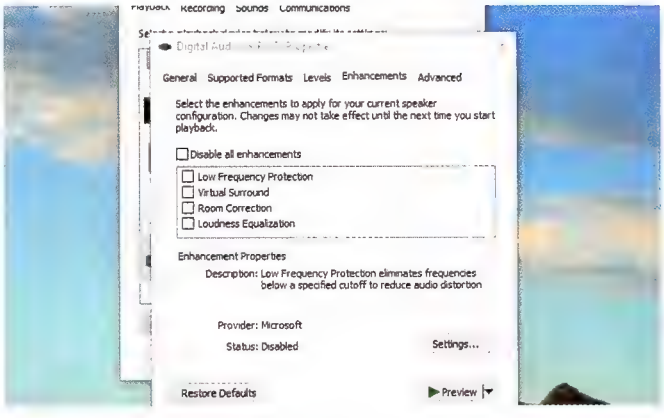
5 CONFIGURE SPEAKERS

If you have surround sound speakers, you can make sure your PC is using them correctly by right-clicking them in the Playback Devices window and selecting 'Configure Speakers'. In the window that appears, select how many speakers there are, and test each one by clicking its icon. Click 'Next', then select which speakers are 'full range' for the best possible sound quality.



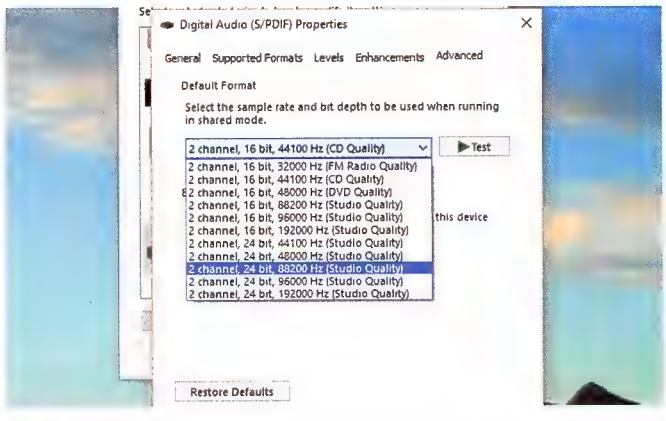
6 CHANGE THE VOLUME FOR A DEVICE

Right-click your playback device, then select 'Properties > Levels' to get greater control over the volume of the device you've selected. From here, you can set the volume using either the slider or by typing in a number. Click the Balance button to tweak the volumes for each speaker. This is useful if you have certain speakers that are positioned closer to where you sit than others.


Digital Audio (S/PDIF) Properties
General Supported Formats Levels Enhancements Advanced
Select the enhancements to apply for your current speaker configuration. Changes may not take effect until the next time you start playback.
Disable all enhancements
Low Frequency Protection
Virtual Surround
Room Correction
Loudness Equalization
Enhancement Properties
Description: Low Frequency Protection eliminates frequencies below a specified cutoff to reduce audio distortion
Provider: Microsoft
Status: Disabled
Settings...
Restore Defaults
Preview

7 ADVANCED SOUND SETTINGS

From this window, you can tweak the advanced sound settings of your device. Click Enhancements to add sound effects. Some of these, such as Equaliser, allow you to tweak the audio quality depending on the type of music you're listening to. Meanwhile, the Voice Cancellation enhancement can help remove vocals from your music — perfect for karaoke sessions.


Digital Audio (S/PDIF) Properties
General Supported Formats Levels Enhancements Advanced
Default Format
Select the sample rate and bit depth to be used when running in shared mode.
2 channel, 16 bit, 44100 Hz (CD Quality)
Test
2 channel, 16 bit, 32000 Hz (FM Radio Quality)
2 channel, 16 bit, 44100 Hz (CD Quality)
2 channel, 16 bit, 48000 Hz (DVD Quality)
2 channel, 16 bit, 88200 Hz (Studio Quality)
2 channel, 16 bit, 96000 Hz (Studio Quality)
2 channel, 16 bit, 192000 Hz (Studio Quality)
2 channel, 24 bit, 44100 Hz (Studio Quality)
2 channel, 24 bit, 48000 Hz (Studio Quality)
2 channel, 24 bit, 88200 Hz (Studio Quality)
2 channel, 24 bit, 96000 Hz (Studio Quality)
2 channel, 24 bit, 192000 Hz (Studio Quality)
this device
Restore Defaults

8 BOOST SOUND QUALITY AND THIRD PARTY SOFTWARE

Finally, click on the Advanced tab and select the sound quality you want. The higher bit-rate you select, the better media on your PC will sound. However, you need to make sure your hardware can handle it, so make sure you press the Test button to make sure everything sounds fine. If you install a sound card, sound bar or headset, be sure to use its software, too.

Try out the iOS 11 public beta

Alan Stonebridge shows how you can take the new features in the next update for a spin.

Installing the public beta of iOS 11 is actually very straightforward, though it's best to install it on a device you don't depend on on an everyday basis – say, to check your bank account and pay bills.

You can restore your device back to iOS 10 if you want to – or at least you can until a short time after the final public release of iOS 11, though Apple doesn't say exactly when.

BACK UP FIRST

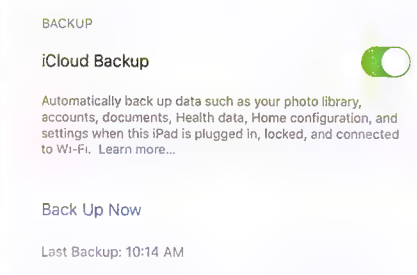
If you decide iOS 11 isn't for you, make sure you roll back as soon as you can spare the time to do so. Note that the process takes longer to complete than simply telling a Mac to switch from starting up High Sierra from one partition to using your previous system on another.

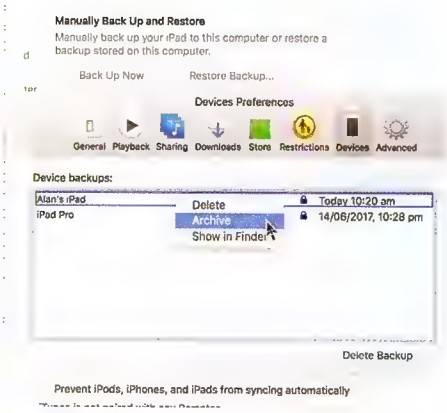
As always with a big software update, the first thing you should do is make a backup of your device. On iOS, you might already be doing this using one of two methods: using iOS's iCloud Backup feature, which backs up automatically when your device is locked, on Wi-Fi, and connected to a power source; or using the device backup capability of iTunes on your Mac.

How to

Install the iOS 11 public beta on iPhone or iPad

iOS 11
A giant step for iPhone.
A monumental leap for iPad.
iOS 11 sets a new standard for what is already the world's most advanced mobile operating system. It makes iPhone better than before. It makes iPad more capable than ever. And now it opens up both to amazing possibilities for augmented reality in games and apps. With iOS 11, iPhone and iPad are the most powerful, personal, and intelligent devices they've ever been.
Get Started
The Apple Beta Software Program is now available for iOS 11. You can enroll your iO device to get the latest public betas from Software Update. If you were testing a prior operating system, please re-enroll your device to start testing the next release
Provide Feedback
The iOS public beta comes with a built-in Feedback Assistant app, which can be launched from the second page of your Home screen. When you come across an issue that needs addressing, send your feedback to Apple with


BACKUP
iCloud Backup
Automatically back up data such as your photo library, accounts, documents, Health data, Home configuration, and settings when this iPad is plugged in, locked, and connected to Wi-Fi. Learn more...
Back Up Now
Last Backup: 10:14 AM



1 ENROL YOUR DEVICE

Go to **beta.apple.com** on the device on which you want to install the iOS 11 public beta, click iOS near the top of the page. Scroll down to the 'Get Started' heading and then click 'enrol your iOS device' in the text below it.

2 BACK UP TO iCLOUD...

You'll be reminded to back up. If you use iCloud Backup, open Settings and tap the row for your Apple ID at the top, then 'iCloud > iCloud Backup'. Tap 'Back Up Now' to make one last backup, and allow it to complete.

3 ...OR iTUNES ON A MAC

To back up using iTunes on your Mac, follow the steps for preparing a device for a beta software update at **bit.ly/prepiosbeta** — do not skip Step 5, as you'll need an archived backup if you want the option to roll back to iOS 10.

Try the tvOS beta

Try out interface tweaks and other improvements to the little black TV box.

The latest tvOS is the easiest to install of all Apple's public betas. There are no backups to make and no profiles to install; you only need the Apple ID you registered with the Apple Beta Software Program. With your Apple ID to hand, simply follow the three steps to the right to set up your Apple TV.

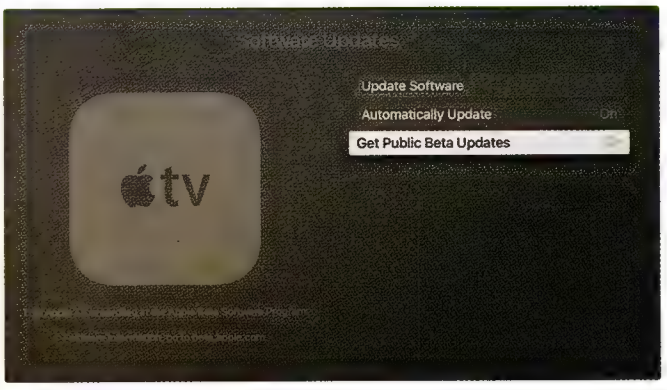
Rather than supplying feedback from your Apple TV, which would be tedious to enter using its Siri Remote, Apple expects you'll also be running the iOS 11 public beta.

FEEDBACK

Consequently, if you have bugs to report or suggestions to make about the tvOS beta, you'll need to open Feedback Assistant on iOS 11 – you'll find it on the Home screen, by entering at least some of its name in Spotlight, or by saying "Open Feedback Assistant" to Siri. Tap the new message icon, then choose your Apple TV under 'Feedback for', or tap 'Other Devices' if you don't see it listed there.

To restore your Apple TV to a non-beta version of tvOS, you'll need a USB-C cable with the corresponding connector for your Mac at the other end. You'll find steps to roll back at **bit.ly/rollbackbeta**.

> "If you have feedback, you'll need to open the Feedback Assistant on iOS 11."



1 PREPARE APPLE TV

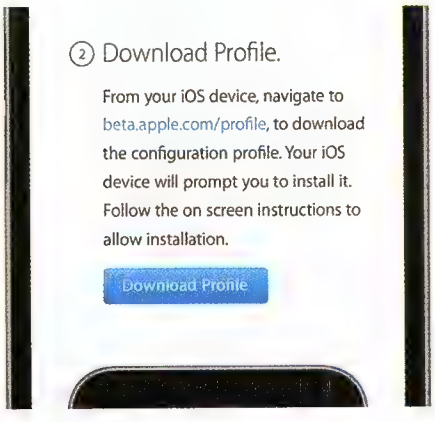
In 'Settings > Accounts', sign in to iCloud, iTunes and App Store, or Game Center using your beta program Apple ID.

2 OPT IN TO BETAS

Go back to the top of Settings, then to 'System > Software Update' and switch on 'Get Public Beta Updates'.

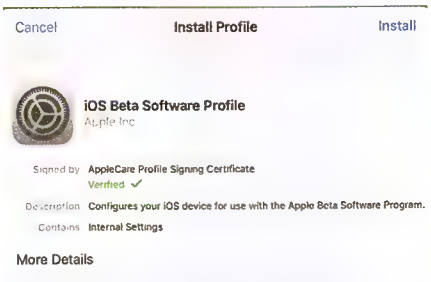
3 RECEIVE AND INSTALL

In the same place, if 'Automatically Update' is switched on, your Apple TV will receive public betas as part of that. Or go to 'Settings > System > Software Updates > Update Software' to check for and install the latest version right away.


2 Download Profile.
From your iOS device, navigate to beta.apple.com/profile, to download the configuration profile. Your iOS device will prompt you to install it. Follow the on screen instructions to allow installation.
Download Profile

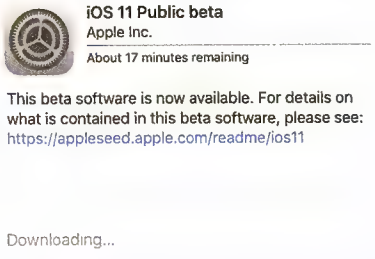
4 DOWNLOAD PROFILE

Under the text of the second step on the web page, click 'Download Profile'. You'll be taken to the Settings app and be shown a summary of the profile; basically, it tells your device to check for and receive beta software updates.



5 INSTALL AND RESTART

Tap Install on the summary and read the reminder that what your device will receive is pre-release software. Tap Install again, then a third time on the confirmation dialogue. When prompted to restart your device, tap Restart.


iOS 11 Public beta
Apple Inc.
About 17 minutes remaining
This beta software is now available. For details on what is contained in this beta software, please see: https://appleseed.apple.com/readme/ios11
Downloading...

6 GET THE BETA ITSELF

When your device restarts, go to 'Settings > General > Software Update' and, momentarily, you'll be told that your device is eligible to receive the iOS 11 public beta. Tap Download and Install, then follow the usual on-screen steps.

Set up extra Apple ID protection

Keep tabs on access to your Apple ID and related services with Alan Stonebridge.

Two-factor authentication (2FA for short) is a protective measure designed to ensure your Apple ID can only be accessed with your explicit approval. With the feature enabled, you'll need more than just your email address and password to sign in to apps and services using your Apple ID.

In addition to those credentials, you'll need to have a trusted device to hand in order to receive a verification code, which is used to confirm that the sign-in request came from you. If whoever is signing in doesn't have one of your trusted devices to hand – and unlocked – they'll be unable to read the code and pretend they are you.

2FA requires that you register at least one trusted phone number to receive verification codes, which can be given as a text message or in an automated phone call. You might also add a number belonging to your partner or a close family member; as long as that person doesn't also know your password, they'll be unable to access your account.

If you haven't got access to any of your trusted devices, you can enter your Apple ID's email address and password to sign in on a temporary or replacement device, then ask your trusted friend to provide you with the code they receive on their phone number when you attempt to sign in.

TRUSTED DEVICES

The downside of needing one of your trusted devices, or being able to reach a trusted contact, is a small price to pay for the reassurance that even if a potential intruder knows your Apple ID's password, they can't access your account – and that you'll be informed about any attempt to break in.

Additionally, 2FA simplifies access to some iCloud features – notably iCloud Keychain, which will no longer require you to set and remember a separate security code to verify attempts to use your keychain; instead, you'll be alerted to the attempt on your trusted devices, from which you can simply choose to allow or prevent access.

After you connect a Mac or iOS device to your iCloud account and verify your identity using 2FA, Apple treats that device as one that's trusted, and in future, it'll receive alerts and verification codes.

In order for 2FA to be effective, ensure that your devices use a strong password and that nobody else knows it; enable other simple security measures, such as automatically locking after a short time; and keep your Apple ID's list of trusted phone numbers up to date at **appleid.apple.com**.

The 2FA spec sheet

YOU'LL NEED...

To use 2FA, you'll need at least one device running iOS 9 or OS X El Capitan or later. Once it's enabled, Apple recommends certain specs (listed here) for the best experience of using it. Apple Watch doesn't receive verification codes, but 2FA must be enabled to use its ability to unlock your Mac (look in your Mac's 'Security & Privacy' prefs). Devices that don't meet the specs shown here will still work with 2FA, but the experience won't be quite as polished — see 'What about older devices?' bubble, right.

What about older devices?

Devices on older systems that lack full 2FA integration use a slightly cruder solution to work with it: append the verification code to your password.

1 MAC
A Mac that's running OS X El Capitan or later, plus iTunes 12.3.

2 IPHONE / IPAD
An iPhone, iPad, or iPod touch running iOS 9 or later.

3 APPLE WATCH
An Apple Watch that's running watchOS 2 or later.

4 APPLE TV
A fourth-gen Apple TV (the kind that comes with a Siri Remote).

Use 2FA

When you sign in to a service or app using your Apple ID on an untrusted device, you'll be prompted for a verification code. A notification will appear on each of your trusted devices; click or tap it, unlock your device if necessary, and you'll see the location from which the attempt supposedly originates, though this can be off by many miles due to being based on IP address. A good rule of thumb is that, if you haven't done anything you think should trigger an alert, choose not to allow access. Otherwise, carry on as normal.

Set up two-factor authentication

ON IOS

On iOS 10.3 or later, open Settings and tap your name at the top of the opening page, then tap 'Password & Security > Turn On 2FA > Continue'.

On iOS 9 up to 10.2, in 'Settings > iCloud', tap on 'Apple ID > Password & Security > Turn On 2FA > Continue'.

ON MACOS

In iCloud's preferences, go to 'Account Details > Security > Turn On 2FA'. If your Apple ID was created on a device running macOS 10.12.4 or iOS 10.3 or later, 2FA may already be enabled.

A FINAL CHECK

On either system, you might need to answer your security questions. Check in Settings/System Prefs that you're still signed in to iCloud, and enter your Apple ID's password if needed.

2FA questions and answers

I'm already using two-step verification, so do I need this?
Two-step verification (2SV) is an older system that's also designed to offer extra protection, but Apple says 2FA is better. To migrate, first go to Security at **appleid.apple.com** and click 'Edit > Turn Off 2SV'.

Does my trusted phone number have to be an iPhone?
No; it can even be a landline. When you add a new number to your Apple ID (at **appleid.apple.com** or 'System Prefs > iCloud > Account Details > Security'), you'll be asked whether to send verification codes to it using SMS or voice calls.

How do I check which devices are trusted and can receive codes?
On a Mac that's signed in to your iCloud account, go to 'System Prefs > iCloud > Account Details > Devices'. Select a device and check its description on the right. You can revoke a device's access to your ID if it's no longer in your possession.

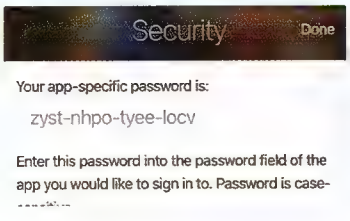
It sounds like 2FA is a bit too much bother. Do I have to use it?
Except for some accounts created using macOS 10.12.4 or iOS 10.3 or later, 2FA can be disabled, but your ID will then only be protected by a password and security questions.

Someone else has enabled 2FA on my account. What should I do?
You'll get a confirmation email. Click 'Turn Off 2FA' in it to revert your Apple ID's security to your old settings. The link works for two weeks. Change your password at **appleid.apple.com** and use the option to sign out of all devices and sites that are using your ID.

Third-party apps

An advantage of enabling 2FA is that you don't then need to provide your Apple ID's password to third-party apps, which you may not entirely trust. Instead, generate an app-specific password. At **appleid.apple.com**, look for 'App-specific passwords' under Security, and click 'Generate Password'. Enter a label for the app or service, then click Create. This is the only time you'll be shown this password; enter it where the app or service requests the one for your Apple ID.

To revoke app-specific passwords, tap 'View History' on iOS, or click Edit, then 'View History' on macOS.


Security
Done
Your app-specific password is:
zyst-nhpo-tyee-locv
Enter this password into the password field of the app you would like to sign in to. Password is case-

The switcher's guide to Linux

You don't need to be a complete beginner to get confused by a new operating system. Nick Peers reveals the answers to all your Linux-related questions.

It's never straightforward moving from one operating system to another. It doesn't matter how well versed you are in Windows, you can't simply transfer everything you know and apply it equally to your new OS – and that's particularly true when it comes to Linux, even when it's as user-friendly as Ubuntu.

Some things translate, of course – how many ways are there to point and click, after all? Nevertheless, there are still fundamental differences in the way Linux operates that you need to understand. Failure to do so could result in you breaking your system.

In this feature, we take you on a tour of the key differences you'll encounter in Ubuntu, and give you a grounding in how they work and what to expect.

To begin, we examine the Linux filesystem, and how it handles users and permissions. There's a brief look at drivers, then we reveal how you find, install, update and manage software. We also introduce you to the Terminal. Don't run away – it's neither scary nor a cure for insomnia. We finish by looking at what's new in the latest release (Ubuntu 17.04). No time to waste; a whole OS is out there, waiting for you to get to know it better.

Navigate the Linux filesystem

Don't be shocked by the way Linux handles files — it's actually quite logical

The Linux filesystem (ext2, ext3 and ext4) is radically different to Windows. The key change is how it references drives and partitions – not as separate, distinct drive letters, but as files within the main filesystem itself.

Open the Dash, and type "disks" to open the Disks utility, to help you visualise how things work. Select a drive in the left-hand menu, and look in the Disks menu bar. You'll see your drive is referenced something like /dev/sda. This refers to the 'dev' (devices) folder, inside which each physical disk is assigned a unique file, which begins 'sd' (for 'storage device'), followed by a unique letter from 'a' to 'z'.

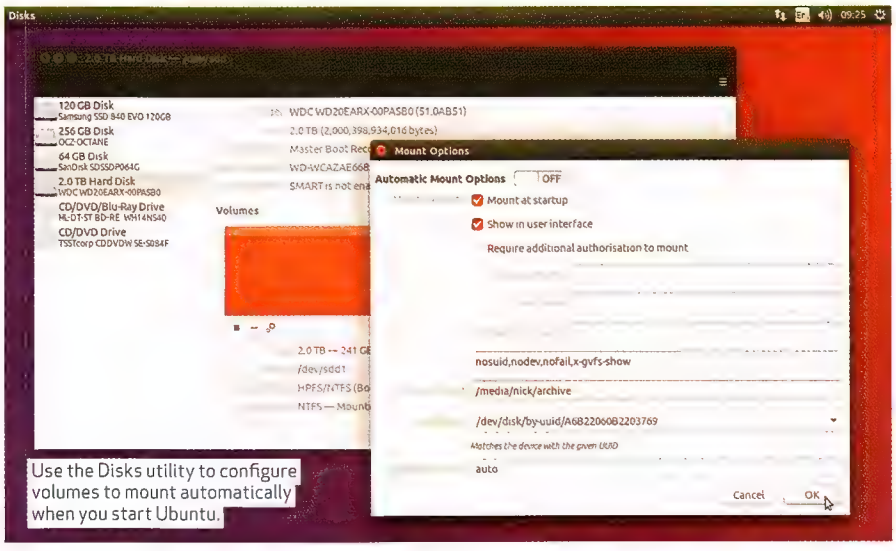
This follows a logical pattern: /dev/sda is assigned to the drive Ubuntu is installed on, with drives then allocated 'sdb', 'sdc' and so on, following the order of internal drives first, then external media (both flash and hard drives). The logic extends to partitioning, so instead of assigning partitions (or 'volumes') separate drive letters, Linux identifies each with individual files named 'sda1', 'sda2' and so on. Partitions are represented in the bar chart for each drive in Disks. Numbering isn't always logical – if your drive is formatted using the MBR (Master Boot Record) partitioning scheme, for example, you may notice any additional partition you've set up is allocated 'sda5' and not 'sda2'. Nothing to worry about, though.

ACCESSING DRIVES

Drives aren't just incorporated into the main filing system as individual files, they're also 'mounted' to specific folders within the filesystem, which is where their contents can be found. Your main system partition (typically /dev/sda1) is mounted to the root directory (/) of the filesystem. Other internal and external volumes aren't mounted by default (although external drives mount automatically if you plug them in after logging on to Ubuntu), while the swap file isn't mounted, period.

The simplest way to access your files and folders is via a file manager – Ubuntu's default Files program is based on a tool called Nautilus, and is similar to File Explorer in Windows. Open it by clicking the filing cabinet icon in the Dash, and you'll see a list of available volumes appear in the left-hand navigation pane. Click one to mount it – an eject button appears when the drive has been successfully mounted.

These shortcuts are convenient, but where are these drives physically mounted within the Linux filesystem? Click 'Computer' in the Navigation pane to navigate to the root directory, then browse to '/media/<yourname>' to find folders pointing to each drive that you have physically mounted.



Use the Disks utility to configure volumes to mount automatically when you start Ubuntu.

It's also possible to mount key folders on separate volumes, too – for example, many Linux installations set up a dedicated partition for the /home folder during the installation process, where all your user settings and data, including such folders as Documents, Downloads and Pictures, are stored. (Ubuntu is one of the few that doesn't do this.)

MOUNT ON STARTUP

If you'd like Ubuntu to automatically mount specific volumes at startup, open the Disks utility, select your drive on the left, then highlight the volume by clicking it on the bar chart. Now click the 'Settings' button beneath it, and choose 'Edit Mount Options'. Flick the 'Automatic Mount Options' switch to On and make sure the first two options are selected, then change the 'Mount Point' field to 'media/user/label', substituting 'user' with your username and 'label' with the volume label. Click OK, then reboot to verify the drive mounts automatically.

Linux isn't Windows

Ubuntu's Unity desktop does a good job of masking the fact that Linux and Windows are very different operating systems. There's the small matter of the filesystem, of course, and Linux is much tighter with security than Windows. Windows has closed the gaps in some areas — file and folder permissions, for example — but in others, Linux remains way out in front. For example, you can't perform an administrative task in Linux — such as installing updates or a program — without supplying your user password. It's this attention to detail that makes Linux far less vulnerable to malware and hackers.

Also, despite appearances, Linux remains very much an operating system that performs best from the underlying shell environment. Unity is a good front end, but as you'll see later on in this feature, don't resist embracing the command line through the Terminal.

Other things to consider: Ubuntu is a much more open, community-supported environment than Windows. It's packed with free (and open-source) software, helping drive down computing costs, but most support is found online, through forums and asking questions of your peers. The way Linux handles software — via centralised repositories and package managers — is another thing you need to get used to.

One final thought: hardware compatibility is no longer the issue it was either. While some devices don't work, you'll find most do, and many don't require any additional configuration — they just work.

Introducing file permissions

Users, superusers and file permissions — controlling access to data.

Any filesystem worth its salt applies restrictions to files in the form of permissions, limiting access based on users and groups. Windows does this to some degree with its NTFS filesystem, but it's no substitute for Linux.

THE BASICS

Everything in Linux is represented as a file, including folders and devices. The ext filesystem applies permissions to these files to determine how they can be accessed and by whom. These boil down to three levels of access: read (r), write (w) and execute (x). You can view a file's permissions in the Terminal with the 'ls -l' command, where you'll see entries such as 'rwx' (full access) or 'r--' (read-only). These rwx permissions apply to both folders and files, and things are complicated by the fact that certain permissions — such as deleting a file — reside with its parent folder, not the file itself. Files can be viewed (r), edited (w) and executed if they're a program (x), but unless their parent folder has 'w' permissions, you can't create (or delete) files within the folder. Similarly, you can't view files unless the folder has 'x' permissions.

OWNERS, USERS AND EVERYONE ELSE

Security is paramount in Linux, so permissions aren't applied directly to each file and folder; they're applied to three categories of user: owner (the user who created the file), specific user group and 'others' (everyone else). The second category refers to a single user group for whom specific permissions have been defined. Although it appears to apply to a specific user (often the file or folder's owner), it actually applies to a user group.

When you create a new user, a group of the same name is also created, your user is added to that group, and it's this group that Linux references here. You can add users to multiple groups, so advanced users can set up groups into which multiple users are added, giving them all the same level of access to a file or folder based on the group.

Permissions are set when a file is created, with the file owner also set as the default user or group for the file. If you create a file when running in elevated mode (such as through 'sudo' in the Terminal), the owner is 'root', not you. The owner typically has full access rights to the file or folder created, while 'everyone else' has more limited rights to files, and is usually blocked from folders.

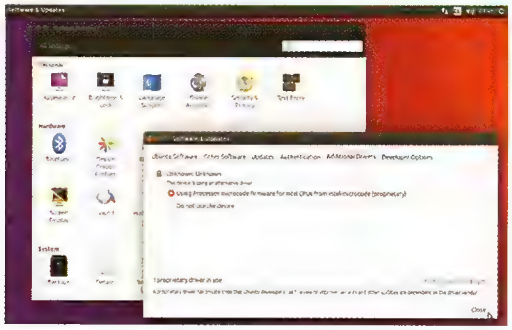
By default, all users have ownership, access and control over their home folder and its contents, while other users are blocked. Outside the home folder, access is more restrictive — certain folders are accessible, but most are read-only or off limits completely, requiring you to access them via the 'root' superuser account.

VIEW AND CHANGE PERMISSIONS

If you're the owner, it's possible to change a file or folder's permissions via the Nautilus file manager. Right-click the folder or file in question, and choose 'Properties > Permissions tab'. From here, you can change permissions for owners, the featured group and 'others', plus change which user group has special access to the item in question. Click the Group drop-down menu, and the list includes a load of unfamiliar names — these are specially created system users, designed to do specific things without compromising on security. There's no reason to use these groups in the context of file and folder permissions, so leave them well alone.

```
nick@nick-pc:~$ ls -l
total 31500
drwxrwxr-x 3 nick nick     4096 Feb 28 08:42 apps
-rw-rw-r-- 1 nick nick      905 Dec 29 16:26 dan-retroshare
drwxr-xr-x 2 nick nick     4096 Feb 28 08:42 Desktop
drwxr-xr-x 5 nick nick     4096 Sep 15 17:42 Documents
drwxr-xr-x 4 nick nick     4096 Feb 23 16:39 Downloads
-rw-rw-r-- 1 nick nick      905 Dec 30 14:41 edc
-rw-r--r-- 1 nick nick     8980 Mar 14  2016 examples.desktop
drwxr-xr-x 3 nick nick     4096 Mar 15  2016 Music
-rw-rw-r-- 1 nick nick      897 Dec 30 14:43 nickp
drwxr-xr-x 2 nick nick     4096 Oct 11 15:56 Pictures
drwxr-xr-x 2 nick nick     4096 Mar 14  2016 Public
drwxrwxrwx 6 nick nick     4096 Jun 17  2016 quicklisp
drwx------ 4 nick nick     4096 Jan  3 09:44 Recovered
```

Use 'ls -l' in the Terminal to view file and folder permissions within the current directory.



Check to see what graphics drivers Ubuntu is using via Software & Updates.

Drivers

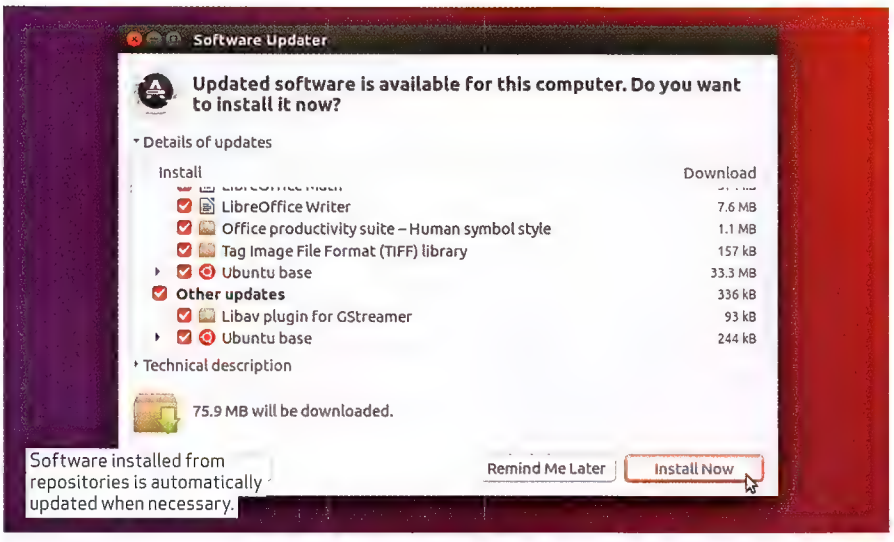
One of Ubuntu's strengths is that 'it just works' and it's gone to great lengths to ensure that, when you install it, you're not left trying to source (never mind install) key drivers. Ubuntu even works with your graphics card or chipset with no problems, although if you plan to use your PC for gaming, you may have to investigate third-party alternatives — Nvidia and AMD users should open System Settings, and go to 'Software & Updates > Additional Drivers'. After a short delay, choose the latest version marked 'proprietary, tested', click Apply, then reboot.

To add a printer, go to 'System Settings > Printers', and click Add to see if it's automatically detected; follow the wizard to see if drivers are included. If not, visit the manufacturer's website to see if there's a Linux driver. If it's a '.deb' package, installation is simple; if not, you may have to look for a '.sh' installer — ensure the file is executable (check 'Allow executing file as a program' on the Permissions tab of the file's properties in Nautilus), open Terminal, navigate to the file's directory, and launch it thus:

```
$ ./filename.sh
```

Installing software

There are many ways to install software — in and outside the Terminal.



Many Linux packages are stored in what are called online 'repositories'. These are channels that usually bundle together software of similar types, built for specific versions of Ubuntu (so Ubuntu 17.04's repos aren't the same as those for Ubuntu 16.10, or indeed 16.04).

There are four main channels for each separate version. The 'Main' repo contains free software that can be redistributed freely and is fully supported by Ubuntu with regular updates. 'Universe' contains a vast array of free and open-source software, where the community provides updates. 'Restricted' houses a small set of proprietary (closed-source) tools and drivers required to support Ubuntu on everyday hardware, while 'Multiverse' contains software that is neither free nor supported. These repos can then be accessed by package managers, such as Software Center, to provide you with a convenient central location for locating, installing and automatically updating packages.

BEYOND REPOSITORIES

The vast majority of programs that you need can be found with these four main repos. If you find the Software Center a bit limited, try a more robust (and a little more advanced) package manager like the Synaptic Package Manager. This provides a more thorough search of repos to help you find the packages you're looking for, and a more comprehensive list of programs out of the box.

Not all programs are available through the default repos — some offer their own, which you can add to your package manager one of two ways: either via 'Settings > Software & Updates > Other Software' or through the Terminal (see right). Once installed, you're alerted to any updates when they're made available by the software maintainers.

Other programs can be downloaded individually as packages, which work in a similar way to program installers in Windows. These contain everything that's needed for the program to run successfully — not just programs, but references to dependencies, too, which you're prompted to install if they're not already on your system. These files often come with a .deb extension — save this to your Downloads folder, then double-click the file to proceed — your package manager should take over at this point. Note that, while it records the installation, your package manager can't detect any updates — that's down to the program or its maintainer.

INSTALL FROM THE TERMINAL

Familiarise yourself with the 'apt' range of tools, and you'll find, most of the time, the Terminal is the quickest and best way to install stand-alone software packages. Start with the following command:

```
$ sudo apt-get update
```

This retrieves the latest package lists (including updated versions) from all installed repositories. The following two commands install and remove software:

```
$ sudo apt-get install <package>
```

```
$ sudo apt-get remove <package>
```

The following updates all installed software:

```
$ sudo apt-get update && sudo apt-get upgrade
```

You can also add repositories via the Terminal. Many third-party repos are hosted at **launchpad.net** and can be added using the following command:

```
$ sudo add-apt-repository ppa:<repository name>
```

The Terminal

While Ubuntu's Unity desktop provides a familiar point-and-click environment for day-to-day tasks, it's no match for the power and versatility of the Linux shell — the underlying command-line environment. And thanks to the Terminal, you can interact with the shell without leaving the desktop.

The shell utilises a language called BASH to run specific commands using a series of tools. Each command follows the same basic structure:

```
$ utility command -option
```

The 'utility' bit is the tool you wish to run — for example, 'cd' to change directory or 'apt-get' to run the package management tool. Some utilities can be run on their own — type 'ls' to get a basic list of all files and folders in a directory, for example.

If you add a 'command' to the utility, you can specify what you want that utility to do:

```
$ apt-get install program
```

This instructs the package management tool to install the named program. The '-option' section is where you specify preferences using 'flags'. Each flag is preceded by one (-) or two (--) dashes. For example, to get more detailed information about the contents of the current folder, type:

```
$ ls -l
```

The '-l' flag ensures you get extra snippets, such as file permissions and owner, plus the date it was last modified, and its size in bytes.

Top tips for Linux switchers

Start making good use of the Terminal with this collection of commands.

There are three ways to get help in the Terminal. Know the name of the tool? Use the '--help' flag: `$ ls --help`

The 'whatis' tool is also useful, providing you with a brief description of a fully formed command:

```
$ whatis apt-get install vlc
```

This describes the 'apt-get' tool, the install argument, and the package 'vlc'. Note: 'whatis' ignores any flags.

The Terminal also provides access to an online manual via the "man" utility. Start with 'man intro' for a detailed intro to the Terminal, and 'man man' for advice on navigating the manual. Pair it with a tool – for example, 'man apt-get' – for a detailed description of that tool.

NAVIGATING THE FILESYSTEM

Open the Terminal, and you start in your home folder. Use 'ls -l' to confirm this. If you'd like to view all hidden files and folders (file names with a period at the beginning, such as '.hidden.sh'), use 'ls -a'. View the contents of subfolders in the current folder with 'ls --recursive'.

The 'cd' command allows you to quickly move between directories. To move inside a subfolder within the current folder, use 'cd Dirname' (folders and files are case-sensitive). To go back up a level, use 'cd ..' or 'cd ../..' to jump up two levels. To navigate to the root directory, use 'cd /' or type 'cd -' to go to your home directory.

Type "cd /path/to/folder" to jump to another folder using its exact path ('cd -/Document' if it's in your home folder). Type "cd -" to go back to the previous directory.

If your folder path contains spaces – for example, a folder named 'Star Trek', you need to encompass the entire path inside single quotation marks, like so:

```
$ cd '~\Videos\Star Trek'
```

COPY, MOVE AND DELETE

Need to manipulate files within the Terminal? Start by familiarising yourself with the 'cp' (copy) and 'mv' (move) tools, which share the same syntax:

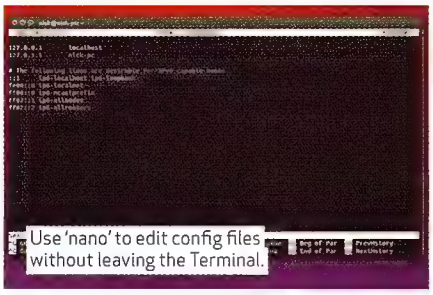
```
$ cp -i source destination
```

Both 'source' and 'destination' can be complete folder paths, or just use the file name if you've already navigated to the folder containing the original file, while the '-i' flag ensures you'll receive a warning if you try to overwrite an existing file of the same name. For example:

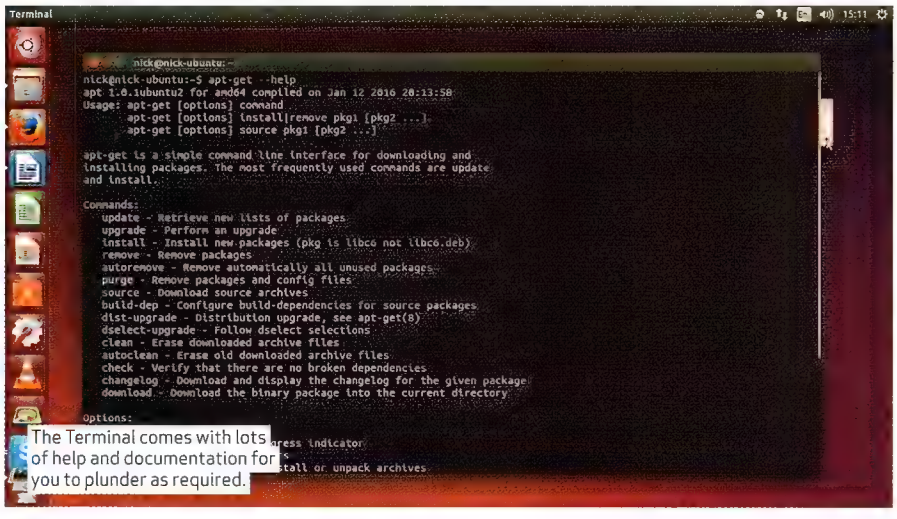
```
$ cp -i invoice.odt ~/Documents/Backup
```

If you want to rename the copied file, simply append it to the end of the destination: '~/Documents/Backup/invoice-backup.odt', for example. Similarly, 'cp invoice.odt invoice-backup.odt' creates a renamed duplicate of the original file in the same folder. Substitute 'mv' if you wish to move – or rename – a file. If you want to copy a folder, use the '-r' flag to indicate recursion, which means the folder and its contents are copied or moved.

Delete individual files using 'rm', and empty folders can be removed with the "rmdir" command (add the '-r' flag to delete a folder and any existing contents):



Use 'nano' to edit config files without leaving the Terminal.


Terminal
nick@nick-ubuntu: ~
nick@nick-ubuntu:~$ apt-get --help
apt 1.0.1ubuntu2 for amd64 compiled on Jan 12 2016 20:13:58
Usage: apt-get [options] command
apt-get [options] install|remove pkg1 [pkg2 ...]
apt-get [options] source pkg1 [pkg2 ...]
apt-get is a simple command line interface for downloading and
installing packages. The most frequently used commands are update
and install.
Commands:
update - Retrieve new lists of packages
upgrade - Perform an upgrade
install - Install new packages (pkg is libc6 not libc6.deb)
remove - Remove packages
autoremove - Remove automatically all unused packages
purge - Remove packages and config files
source - Download source archives
build-dep - Configure build-dependencies for source packages
dist-upgrade - Distribution upgrade, see apt-get(8)
dselect-upgrade - Follow dselect selections
clean - Erase downloaded archive files
autoclean - Erase old downloaded archive files
check - Verify that there are no broken dependencies
changelog - Download and display the changelog for the given package
download - Download the binary package into the current directory
Options:

The Terminal comes with lots of help and documentation for you to plunder as required.

Use 'lshw' to create an HTML file displaying a handy summary of your PC's hardware.

Get system information

The Terminal provides a host of tools for divulging key info about your hardware. Start with the following command for a table-like summary of your hardware:

```
$ sudo lshw -short
```

You can also output a full-blown detailed report for viewing in a browser:

```
$ sudo lshw -html > sysinfo.html
```

Other related tools include 'lscpu' (CPU info), 'lsblk' (storage devices), 'lspci' (internal hardware) and 'lsusb' (USB devices). They all work differently – for example, 'sudo lspci -v' provides a summary, while 'lsusb' works best if you identify the device you wish to check out via 'sudo lsusb', then use the following based on its bus and device number:

```
$ sudo lsusb -D /dev/bus/usb/00x/00y
```

Finally, 'dmidecode' provides useful information via the '-t' flag and keywords such as 'bios', 'baseboard' (mobo), 'processor', 'memory' and 'chassis' – for example, 'sudo dmidecode -t memory'. But be warned: the DMI tables it polls aren't always accurate, so don't be shocked if things don't stack up.

```
$ rmdir -r ~/Documents/Backup
```

Create folders using 'mkdir foldername' (again, full paths are supported) and use 'touch filename' to create a new, empty file – for example, 'touch config.sys'. When creating folders with spaces in the name, surround them with single quotation marks or place a backslash (\) before the space – for example, 'mkdir Star\ Trek'.

CHANGE PERMISSIONS

Nautilus provides some tools for tweaking permissions, but it's quicker to use 'chmod' with the following syntax:

```
$ chmod 777 file
```

The 'file' is obviously the name of the file, and can also refer to a folder. If you want to set all the folder's contents –including subdirectories – to the same permissions as the folder itself, add the '-R' flag, like so:

```
$ chmod -R 777 folder
```

The key element is the '777', which refers to the permissions: '7' stands for 'rwx' (full access), and the first number refers to the file owner, the second to the file's group, and the third to 'everyone else'.

Other numbers worth considering are '6' (rw- or read/write but not execute), '5' (r-x or read and execute) and '4' (r-- or read-only). So assign 644 to a folder or file and you're giving the owner read and write access, but restricting all others to read-only access. Set 775 and you're giving the owner and named group full access, while everyone else can read and execute the file.

Before diving into permissions, read **help.ubuntu.com/community/FilePermissions** for a full brief.

CHANGE USER AND OWNER

If you want to change the owner or group of a selected file or folder, use the 'chown' command.

```
$ chown user file
```

You can use 'chgrp' to change the group of a file, using the same syntax ('chgrp group file') or use 'chown' to change both user and group with one command, like so:

```
$ chown owner:group file
```

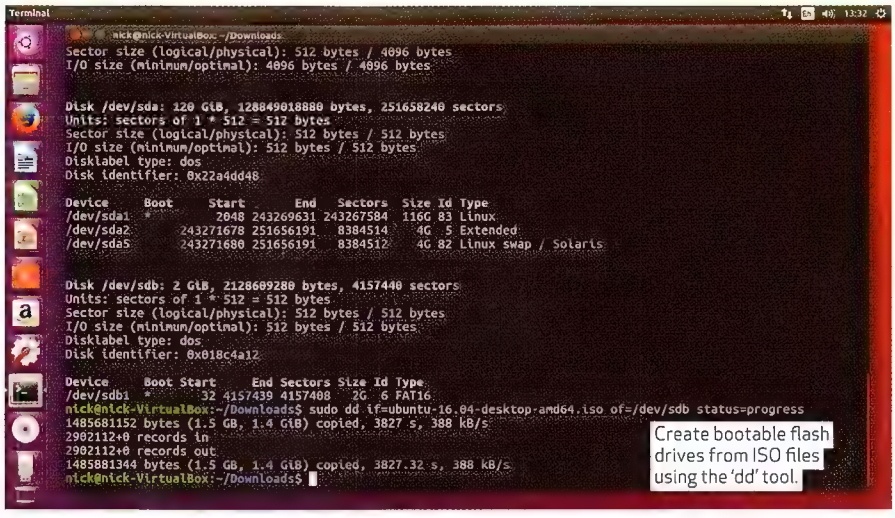
RUN MULTIPLE COMMANDS

There are three ways to join two or more commands together on a single line (allowing you to go off while your PC gets on with it). If you only want the second command to run if the first completes successfully, use '&&':

```
$ sudo apt-get update && sudo apt-get upgrade
```

If you wanted the second command to run only if the first command failed, then substitute '||' for '&&'. Finally, use a semi-colon (;) to run the second command regardless of what happens with the first:

```
$ sudo apt-get update ; sudo apt-get remove vlc
```


Terminal
nick@nick-VirtualBox: ~/Downloads
Sector size (logical/physical): 512 bytes / 4096 bytes
I/O size (minimum/optimal): 4096 bytes / 4096 bytes
Disk /dev/sda: 120 GiB, 128849018880 bytes, 251658240 sectors
Units: sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disklabel type: dos
Disk identifier: 0x22a4dd48
Device Boot Start End Sectors Size Id Type
/dev/sda1 * 2048 243269631 243267584 116G 83 Linux
/dev/sda2 243271678 251656191 8384514 4G 5 Extended
/dev/sda5 243271680 251656191 8384512 4G 82 Linux swap / Solaris
Disk /dev/sdb: 2 GiB, 2128609280 bytes, 4157440 sectors
Units: sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disklabel type: dos
Disk identifier: 0x018c4a12
Device Boot Start End Sectors Size Id Type
/dev/sdb1 * 32 4157439 4157408 2G 6 FAT16
nick@nick-VirtualBox:~/Downloads$ sudo dd if=ubuntu-16.04-desktop-amd64.iso of=/dev/sdb status=progress
1485681152 bytes (1.5 GB, 1.4 GiB) copied, 3827 s, 388 kB/s
2902112+0 records in
2902112+0 records out
1485881344 bytes (1.5 GB, 1.4 GiB) copied, 3827.32 s, 388 kB/s
nick@nick-VirtualBox:~/Downloads$
Create bootable flash drives from ISO files using the 'dd' tool.

EDITING WITH NANO

One popular use for the Terminal is to edit configuration files. The best tool for the job is 'nano', which works just like a regular text editor. Invoke it thus:

```
$ sudo nano /path/filename
```

You'll see the Terminal change to the Nano interface – the file name and path are listed at the top, and a list of basic commands are shown at the bottom; the ^ symbol refers to the Ctrl key. Your file's contents take up the main area of the Nano interface – there's no text wrapping, so look for '$' symbols on the right indicating the line doesn't fit (resize the window or press End to jump to the end of the line).

Use Home and End to jump to the start and end of a line, or PgUp and PgDn to move pages at a time. Press 'Alt-/' to go to the bottom of the document and 'Alt-\' to jump back to the top. Use 'Ctrl-W' to search your file, pressing 'Alt-W' to look for additional matches.

WRITE TO USB

Need to create a bootable USB drive from an ISO file you've downloaded? The 'dd' tool leaps to the rescue, but use with care – the following command wipes the target drive as part of the copy operation, so be sure you've identified the correct drive before you begin using 'sudo fdisk -l':

```
$ sudo dd if=filename.iso of=/dev/usb status=progress
```

Substitute '/dev/usb' with the correct drive identifier (such as '/dev/sdc').

Su-Su Sudo

When you open the Terminal, you log on to the underlying shell via your user account, with limited access to the Terminal. Certain commands require elevated access as the root user (look for 'permission denied'), and you achieve this by preceding the command with 'sudo', like so:

```
$ sudo apt-get install vlc
```

You're prompted for your own user account password, and the command now runs — you should now be able to use 'sudo' again during the current Terminal session without being prompted for your password. By the way, if you forget to include 'sudo' in a command, just type 'sudo !!' and hit Enter to repeat the command with sudo applied.

If you want to launch a desktop app with root privileges (such as the Nautilus file manager), use the 'gksu' tool, which you first need to install as follows:

```
$ sudo apt-get update && sudo apt-get install gksu
$ gksu nautilus
```

Nautilus opens as normal, but with elevated access. Make sure you leave the Terminal open while the app is running, otherwise it closes when the Terminal does. When you're done, close the app window, then press 'Ctrl-C' in the Terminal, which interrupts the currently running program, and returns you to the command line.

Some distros allow you to log on to the command line as the root user with the 'su' tool, but Ubuntu explicitly blocks this, and for good reason. We suggest sticking with the 'sudo' tool instead.

Swap out your desktop

Ubuntu is changing its default desktop, so why not try alternatives?

One of Linux's strengths is its versatility, and unlike other OSes, that extends to your desktop. Each flavour of Linux ships with its own desktop environment, and while they share superficial similarities – specifically the point-and-click WIMP interface – there can be quite radical differences, in functionality, as well as look and feel.

Ubuntu 17.04 ships with two desktops: Ubuntu and Unity8. Ubuntu is the Unity7 desktop, which developer Canonical has announced will be dropped from Ubuntu 17.10. Unity8 is incomplete, full of bugs and not suitable for day-to-day use, but is worth checking out to see what may have happened if Canonical continued development.

The good news is that you're not restricted to either – Linux allows you to install multiple desktops and switch between them, so you can compare different desktops side-by-side, or set up different ones for different uses.

CHOOSING A DESKTOP

Desktops are distributed as software packages. Once they've been installed, you switch between them from the login screen, by clicking the desktop icon that appears in the 'log on' box next to your username. There are lots available, but many share similar traits. This is because these are all based on one desktop called GNOME (**www.gnome.org**), which will become the default Ubuntu desktop as of the next Ubuntu release. The box reveals how to install it, along with another GNOME variant, Cinnamon (**developer.linuxmint.com**). One notable exception to the GNOME rule is KDE Plasma 5 (**www.kde.org**), which offers a radically different desktop that will appeal more to advanced users.

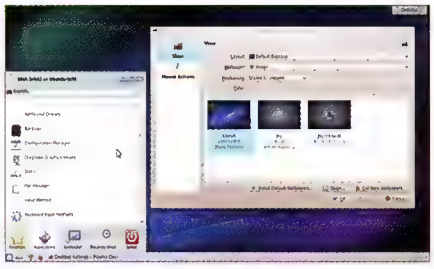
Which desktop is best for you? Looks play a part, but there are questions surrounding configurability, user-friendliness and performance. There's also a question of performance and power consumption. Unity and KDE 5 are better suited to powerful desktops, while lightweight alternatives such as Xfce (**www.xfce.org**) and LXDE (**www.lxde.org**) are perfect for older PCs and laptops. Run a couple, and see how they perform – you should notice those with a smaller footprint are the most responsive. They also place fewer demands on power consumption, which should benefit those running on batteries.

Thanks to the fact you can easily switch desktops, you could run two or more for different purposes, such as a lightweight desktop for working on the go, while switching to GNOME or Unity when plugged into the mains.

WORKING WITH DESKTOPS

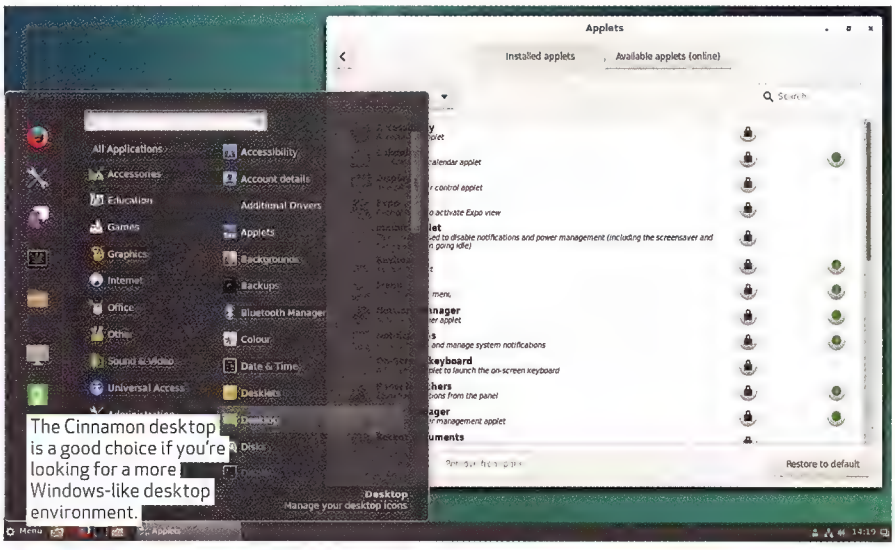
Once you've installed a new desktop (or two), log out of your account. When you're back at the login screen, you should see an icon next to your username. Click this, and you'll see a list of available desktops – in some cases, you'll see multiple options based on a single desktop. Select one, then enter your password and log in as normal to start using it.

When you log in to a new desktop for the first time, it's a blank canvas – none of your preferences come across from your old desktop (don't worry, they're all still there, ready and waiting for you when you log back into your original desktop).



KDE Plasma 5 offers a radically different desktop experience, but comes with a steeper learning curve.

One of the benefits of having to make changes to your new desktop early on is that it forces you to explore it, providing insight into how it works. And if you don't like this desktop? No problem, just switch back or try another.



Two desktops to try

If you want to get ahead of the curve and install the GNOME desktop that future versions of Ubuntu will be using, open a Terminal window, and type the following commands:

```
$ sudo apt-get update
$ sudo apt-get install ubuntu-gnome-desktop
```

A configuration wizard appears — choose the 'lightdm' option when prompted. Once installed, log out and click the Ubuntu logo next to your username — you'll see three new options, all variants of GNOME 3 (vanilla, Classic, and Wayland). Select one and log in to switch desktop.

Don't like GNOME? Itching for something a bit closer to the Windows desktop you left behind? Then give Cinnamon a try instead — it's the official desktop for Linux Mint:

```
$ sudo apt install cinnamon-desktop-environment -y
```

Cinnamon is highly configurable. Its main customisable elements — known as 'spices' — are its themes, applets, desklets (widgets you can place on the desktop) and extensions. These enable you to radically alter its capabilities, as well as its look and feel.

What's new in Ubuntu 17.04?

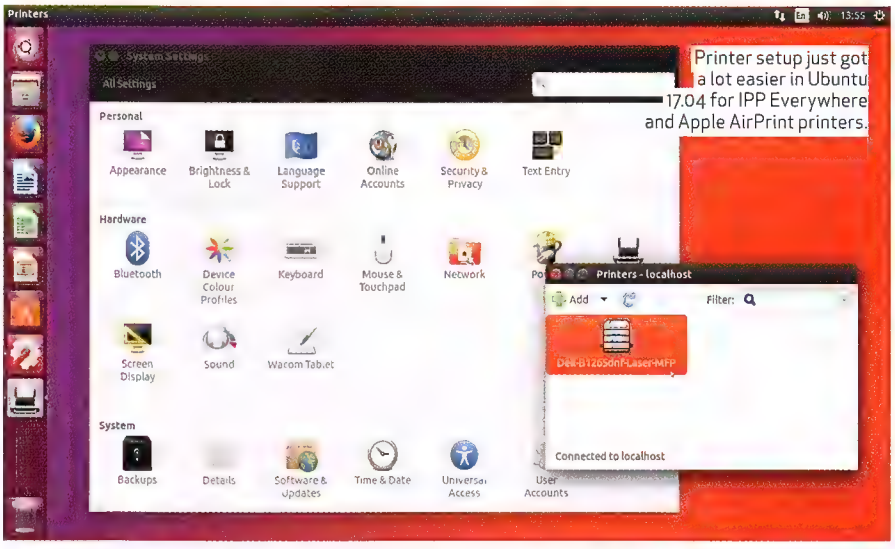
Discover what's new, improved and removed in the latest release.

Ubuntu 17.04 was released only a couple of months ago, and contains several new features and beneath-the-hood changes. The release was overshadowed by the news that Canonical – Ubuntu's developer – has decided to retire its current desktop, Unity. All development has been ceased, and while Unity 7 remains the default for this release, it will be replaced by the GNOME desktop in Ubuntu 17.10.

But what else is new? One change – hidden from view – is that Ubuntu has switched from storing virtual memory in a separate, dedicated partition to using a swap file in a similar fashion to Windows. If you're upgrading to Ubuntu 17.04 from an earlier release, the existing partition structure remains in place, but if you install from scratch, it defaults to a single partition with swap file. If you don't like this, you can manually configure the swap partition during setup by using the 'Something else' option. If you're configuring a dual-boot system, don't follow this step unless you know what you're doing.

DRIVERLESS PRINTING

An increasing number of printers now work without the need for drivers – if you have a printer marked as IPP Everywhere or Apple AirPrint compatible, you no longer need to install drivers to make it work in Ubuntu. A handful of PDF, PostScript and PCL printers also work, and all you need to do is plug them in via USB or Ethernet, then go to 'Settings > Printers', where you should find they're already detected, and ready to use or configure.



Printer setup just got a lot easier in Ubuntu 17.04 for IPP Everywhere and Apple AirPrint printers.

UNDER THE HOOD

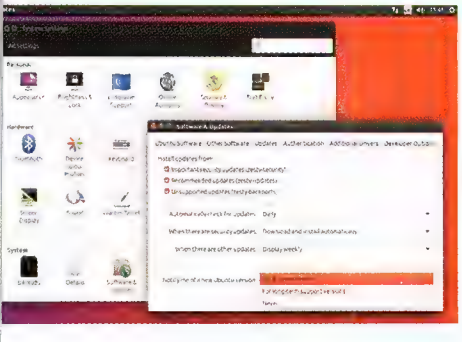
Ubuntu 17.04 bases itself on the Linux kernel 4.10, so you can run it on the latest Kaby Lake and Ryzen systems. It also includes a big bump in the Mesa 3D graphics library to version 17.0.2, while X.Org Server 1.19.2 is also included. Both are good for gaming.

The default apps have been updated – most notably LibreOffice 5.3, which includes the new ribbon-based interface and the Calendar, which now offers a weekly view. A full list of changes can be found at **wiki.ubuntu.com/ZestyZapus/ReleaseNotes**.

TOWARD UBUNTU 17.10

If Ubuntu 17.04 is a relatively minor update, there are larger ripples on the horizon. We've mentioned how Ubuntu 17.10 will be the first version to sport the GNOME desktop, which will be tweaked for Ubuntu users. Canonical is busy integrating the current Ambiance and Radiance themes to work with GNOME. However, certain features exclusive to Unity won't be forthcoming in this next release – if you like the heads-up display or global menus, you'll have to source alternatives. Unity will remain an option if you upgrade from Ubuntu 17.04, or you'll be able to install it as an alternative desktop on new Ubuntu 17.10 installs.

Ubuntu 17.10 will ship with a new default windowing system, replacing the X Window System (in the form of the X.Org Server) with a simplified replacement called Wayland, which comes with the promise of performance improvements. X.Org Server should remain an option for now at the login screen, for backward compatibility purposes.



Make sure you upgrade to Ubuntu 17.10 when it's released by configuring this setting.

How Ubuntu upgrades work

Ubuntu releases major new versions of itself every six months. These are named for the year and month they're released (4 for April, 10 for October). So the latest release, Ubuntu 17.04, was released in April 2017. Each regular release is supported for just nine months, by which time, you're expected to have upgraded to a newer version (you can upgrade from a previous version by going to 'Settings > Software & Updates > Updates tab' and choosing 'For any new version' under 'Notify me of a new Ubuntu version').

The next major release will be Ubuntu 17.10, released in October and support for Ubuntu 17.04 will end in January next year.

Every two years, a special version with extended support is released. These Long Term Support (LTS) versions are supported for up to five years. The latest is Ubuntu 16.04.2 LTS (the .2 stands for the latest bug and security fix release).

Each new version of Ubuntu is also known by a codename, using the next available letter of the alphabet. Ubuntu 16.04 LTS is codenamed Xenial Xerus, while Ubuntu 17.04 has been given the name Zesty Zapus. Ubuntu 17.10 will be Artful Aardvark, as the letters reset to A once the alphabet runs out.

Limit game frame rates without using V-sync

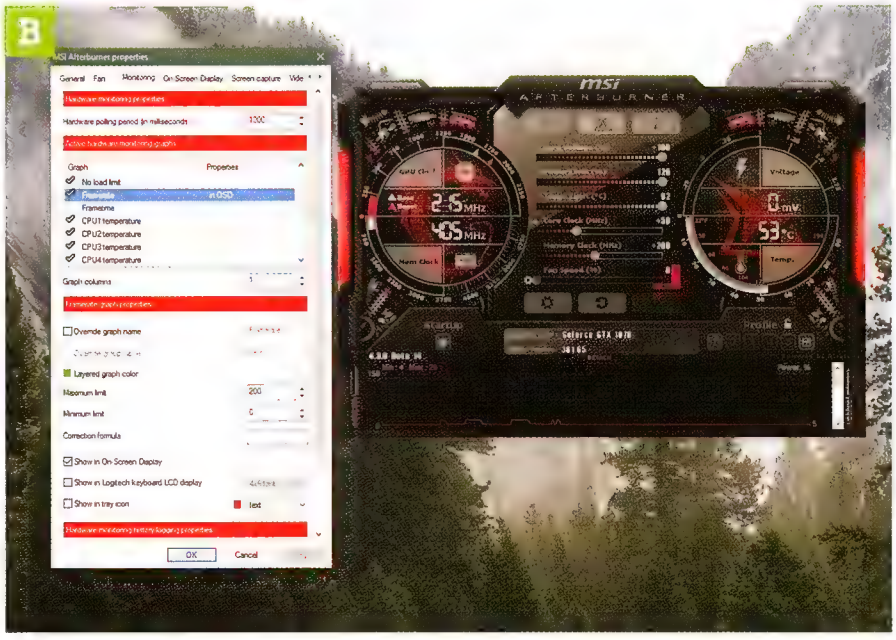
Phil Iwaniuk reckons you can sometimes have too much of a good thing.

Counterintuitive as it may seem to the PC enthusiast, sometimes your frame rate is too high. It might be that your fondly remembered classic game is running like a VHS tape stuck on fast forward, because it was never designed to run on those four GTX 1080s you plumped for. It may be that you're getting a variable frame rate in a game that doesn't offer its own limiter or V-sync option, and you're sick of the stutter, even above 60fps. Or after several alarmingly high electricity bills and considerable hearing loss from listening to your red-hot GPU whine and blow a gale, you might decide that, actually, 2,500fps is more than you need in *Counter-Strike: GO*.

The reasons are multitudinous, and consequently the methods are, too. You'll want to take a different approach if you're frame-limiting an old game on an Nvidia card, for example, than if your objective is locking out a solid 60 in a DX12 title with AMD silicon in your PC. Happily, although the methods vary, they're unilaterally simple, and basically amount to finding the right option in the right screen, entering a figure and checking a box. But, oh, the satisfaction of seeing that unwavering number in the top-left...

1 CONSIDER V-SYNC AS AN ALTERNATIVE

It's a good idea to take V-sync completely out of the equation before heading into frame limiter territory.

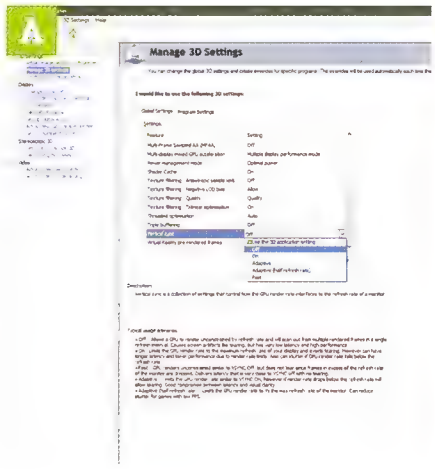


However, it's also a good idea to make sure V-sync isn't actually the answer to your problems. If you're gaming on a 60Hz monitor, say, and you're being tormented by frame dips above 60fps, turning V-sync on is the best solution, because it locks the FPS output to an even division of that refresh rate. Plus, you get to eliminate screen-tearing in the process, which is a nice little kickback.

However, when running old games, trying to even out dips below 60fps, or looking to reduce power output and temps caused by unnecessarily high frame rates, limiters are the way to go, because they cap menu screens and cinematics, too. Make your call, and proceed. There's also the world of frame limiting to improve V-sync lag — we'll get to that later.

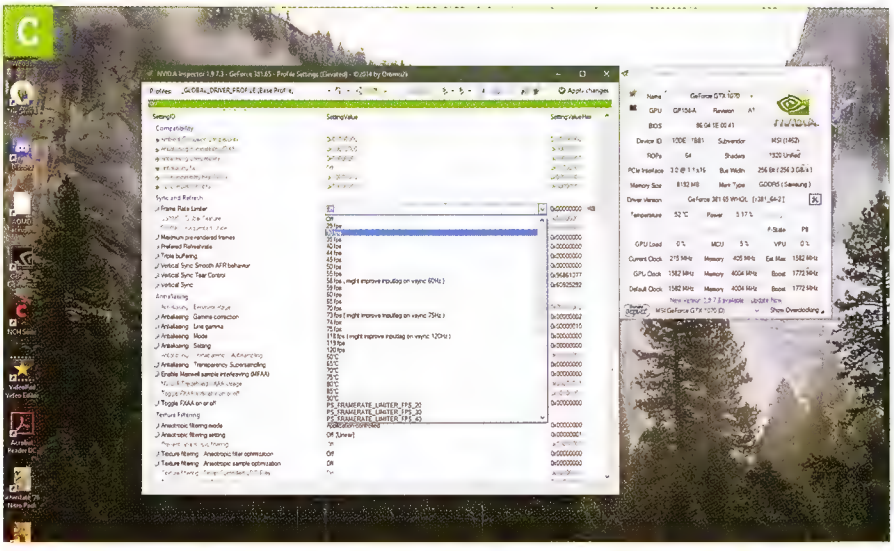
2 TURN OFF V-SYNC

For Nvidia cards, head to the Nvidia Control Panel and set 'Vertical sync' to 'Off' in "Global settings" [**Image A**]. For AMD cards, find the 'Frame rate control' header in Radeon's software, and disable 'Wait for vertical refresh'. Quick and painless. You need to visit the graphics options screen of the game



Limiting Intel onboard graphics

No, we're not joking. Having too many frames per second is admittedly extremely rare when you're relying on an integrated graphics solution to do all the heavy lifting in your games, but there are cases when setting a limiter makes sense. Laptop battery life can be extended massively, for example, by capping the frame rate. If you're getting performance in the mid-40s anyway, a 30fps cap doesn't adversely affect your experience, but does gain you lots more unplugged time. The bad news: it's harder to find a program to limit frames on Intel graphics. Turning V-sync on in the Graphics Control Panel is the simplest solution, but for more control, your unlikely salvation comes from Bandicam's screen capture software. Most capture apps have a frame cap while recording, but Bandicam enables you to set a cap regardless of whether the red light's on. Don't worry — there's no performance hit from running it in the background.



> "In order to check that your limiter is working once you've set it up, you need a good, reliable counter overlay."

in question, too, and disable all V-sync options there. Leaving V-sync on while running a cap might tank your FPS to half the desired rate, and has the potential to provide any number of complicating factors that you could do without.

3 ENABLE MSI AFTERBURNER'S FRAME COUNTER

In order to check that your limiter is working once you've set it up, you need a good, reliable counter overlay. FRAPS once ruled the roost, but doesn't play nice with DirectX 12, and common alternatives from Steam, Nvidia and AMD can be a little limiting. For that reason, we pick MSI Afterburner.

Don't worry, it works fine on non-MSI cards of both denominations, but it does take a bit more setting up than usual. Hit the cog button on Afterburner's main overlay, and you'll find an options screen, with several tabs at the top. Navigate to Monitoring, check the 'Frame rate' option, then the 'Show in on-screen display' option below that [**Image B**]. Do the same for GPU temperature and fan speed, so you can see the benefits of your limiter. In the next tab along, 'On-screen display', choose a shortcut key to toggle the overlay on and off.

4 SET A LIMITER

So your love for *Interstate '76* is undying, but trying to play it with a frame rate well into the hundreds results in unmanageable handling. We've all been there. Setting a limiter solves your problems, and brings the game back down to a playable speed, but it's not always plain sailing. For example, if the game in question is so old that it's using a software renderer, or you're emulating a 3dfx card to run it in the first place, setting a limiter in many programs doesn't work, because the game isn't trying to communicate with your graphics drivers directly, in the same way as a modern game does.

For newer games, it's less of a dark art, but in both cases, we've found Nvidia Inspector to be the best program for — you guessed it — Nvidia cards. Locate the spanner and screwdriver symbol in the program's UI, and you'll open a huge options screen. Simply find 'Frame rate limiter' under the 'Sync and refresh' header, and select your target frames per second [**Image C**].

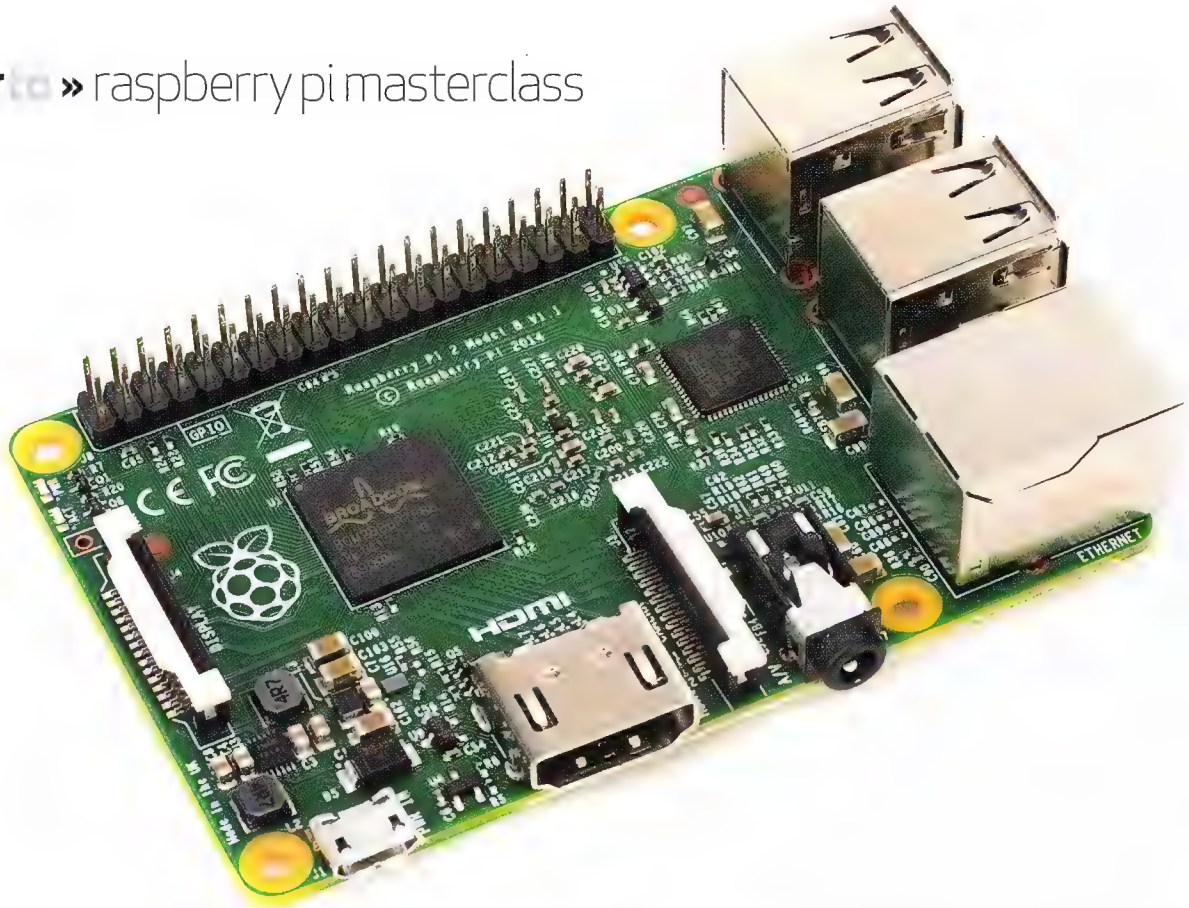
The good news for AMD gamers is that Radeon's Frame Rate Target Control utility, bundled into Radeon Software, is actually pretty effective. Under 'Game settings', find or add the game you want to cap, and scroll the bar along to the desired frame rate. And if that doesn't work, we found RivaTuner Statistics Server to be a decent contingency plan for AMD cards, too.

5 REDUCE V-SYNC LAG

V-sync has a lot to do in a very short space of time. In the process of arranging your GPU's frames and serving them at just the right time for your monitor's refresh rate, a bit of input lag can creep in. However, introducing a limiter can reduce that lag. Using the methods described in the previous step, you can set a limiter of 58fps to achieve a smoother experience on a 60Hz monitor with V-sync enabled, 73fps for a 75Hz display, and so on.

6 TEST THE RESULTS

This is where the GPU temp and fan speed readouts in the Afterburner overlay come in handy. Load up the game you want to limit [**Image D**], hit that shortcut key, and observe the overlay. You should see a lovely consistent frame rate, and reduced load on your card. Measuring V-sync lag is a less exact science, but hopefully you'll feel a difference at 58fps. ■



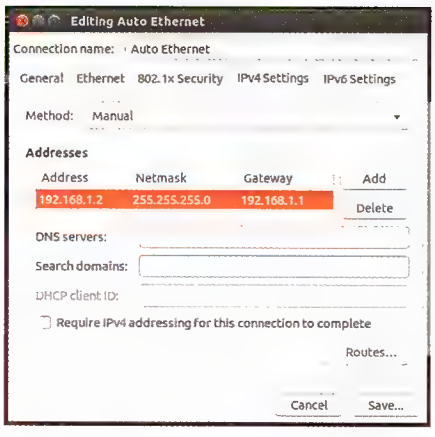
Turn a Pi into an OpenWRT router

Learn the basics of OpenWRT using a Raspberry Pi as a router.

Controlling the interconnects between various devices is paramount to keeping systems secure and safe. Sadly, most router operating systems are closed source – finding vulnerabilities in them is difficult to impossible. Running dedicated open-source router operating systems is not a solution for the average user, as they tend to demand high-end hardware with prohibitively high prices.

OpenWRT is an affordable and efficient alternative. It foregoes some of the complexities found in traditional router operating systems, thereby allowing for lower hardware requirements. The community has ported the system to various routers: with a little care, a compatible router can be found for $150 or less.

Invest a few hours of your time to transform it into a lean and mean fileserver, torrent client or – configurations allowing – even a system capable of controlling real-world hardware via serial links. Here, we will introduce you to the basics of OpenWRT using the well-known single-board computer. That knowledge can then be applied




```
Please press Enter to activate this console.
[    8.852972] NET: Registered protocol family 10
[    8.881403] ip6_tables: (C) 2000-2006 Netfilter Core Team
[    8.901576] hidraw: raw HID events driver (C) Jiri Kosina
[    8.930744] ip_tables: (C) 2000-2006 Netfilter Core Team
[    8.946261] nf_conntrack version 0.5.0 (14892 buckets, 59568 max)
[    9.028739] usbcore: registered new interface driver usbhid
[    9.038935] usbhid: USB HID core driver
[    9.055374] xt_time: kernel timezone is -0000
[    9.070444] PPP generic driver version 2.4.2
[    9.080318] NET: Registered protocol family 24
[   11.308055] smsc95xx 1-1.1:1.0 eth0: hardware isn't capable of remote wakeup
[   11.323760] device eth0 entered promiscuous mode
[   11.336194] IPv6: ADDRCONF(NETDEV_UP): br-lan: link is not ready
[   21.231381] random: nonblocking pool is initialized
```

to a variety of other, more suitable hardware solutions.

1 SET IT UP

Deploying an operating system requires you to be in possession of a suitable image: due to differences in the hardware, RPi 1 and 2 are targeted with different files which can be downloaded at **bit.ly/1T7t4UC**. The following steps are performed on a Raspberry Pi 2 using Chaos Calmer 15.05.1. Burn the image 'openwrt-15.05.1-brcm2708-bcm2709-sdcard-vfat-ext4.img' to the SD card in a fashion of your choice: Ubuntu's Image Writer is the utility shown in the figure. Finally, insert the SD card, connect the RPi's native Ethernet port to your PC and power up the contraption. Interested individuals can connect an HDMI monitor in order to see the boot process 'live'.

2 GET CONNECTED

Starting OpenWRT on a Raspberry Pi 2 takes about half a minute: when done, the message shown in the figure will appear. At this point, the Ethernet port of the Raspberry Pi 2 will be set to a fixed IP address of 192.168.1.1 and will await network connections from other workstations. Open the 'Network connections' applet of the host, and configure it to use a static IP address via the settings shown in the figure.

Be aware that 192.168.1.1 is a popular address for routers: if your Wi-Fi router uses it, the network connection needs to be disabled during the following steps.

3 TELNET OR SSH?

Chaos Calmer 15.05.1 keeps the Telnet service open on unconfigured instances. The first bit of work involves connecting to the Telnet client: invoke the passwd command to set a new password. Complaints about low password strength can be ignored at your own peril: passwd will not actually prevent you from setting the passcode to be whatever you want, but hackers might be delighted about the easier attack vector.

Once the new root password is set, the Telnet server will disable itself. From that moment onward, your OpenWRT instance can only be controlled via SSH.

```
  tamhan@tamhan-thinkpad:~$
telnet 192.168.1.1
  Trying 192.168.1.1...
Connected to 192.168.1.1.

Escape character is '^]'.
  . . .

  root@OpenWrt:/# passwd
  hanging password for root

  New password:

  Bad password: too short
  Retype password:

  Password for root changed by
root
  - - -

  tamhan@tamhan-thinkpad:~$
ssh
   root@192.168.1.1

  The authenticity of host
'192.168.1.1
   (192.168.1.1)' can't be
established.

   RSA key fingerprint is
   11:80:4b:14:cc:b8:9a:a6:
42:ba:bf:8d:96:2a:1b:fa.
   Are you sure you want to
continue connecting
   (yes/no)? yes

   Warning: Permanently added
'192.168.1.1'
    (RSA) to the list of known
hosts.
```

Pi bites

On paper, the RPi 3's embedded Wi-Fi module makes it a perfect access point.

In practice, this is not the case for two reasons: first of all, the range of the module has been shown to be abysmal in lab tests. Second, BroadComm has not released the driver code — at the time of going to print, its use in OpenWRT is unsupported.

```
  tamhan@tamhan-thinkpad:~$
sudo nmap -sn
   192.168.1.0/24

  Starting Nmap 6.40 ( http://
nmap.org ) at
  2016-05-03 21:14 CEST
  . . .
  Nmap scan report for
192.168.1.104

  Host is up (-0.099s
latency).
  MAC Address:
B8:27:EB:53:4E:D9 (Raspberry
Pi Foundation)
```

> "Even though dongles based on the ASIX AX88772B are quite common, not being able to procure one does not totally condemn your experiment to failure."

4 LET'S PLAY NICE

The following steps assume that your router will live behind another router. As the activation of USB support requires the downloading of a batch of packages, our first act involves making OpenWRT play nicely with the rest of the network. As the stock distribution includes only vi, open the web interface by entering "http://<ip>" into a computer of your choice. Next, click 'Network > Interfaces' and click Edit next to 'br-lan'. Set the protocol field to DHCP client and select the Switch Protocol button. Finally, click 'Save & Apply', close the web page and disconnect the RPi from your PC. Next, connect both PC and Pi to the existing router and run nmap as root in order to find its newly-assigned IP address.

The command shown here is a little nifty in that it instructs nmap to scan the entire 255 addresses of the subnet — be sure to adjust it to your local environment. Furthermore, keep in mind that the IP settings of the PC must be restored to the ones used originally, with a reboot recommended for good practice.

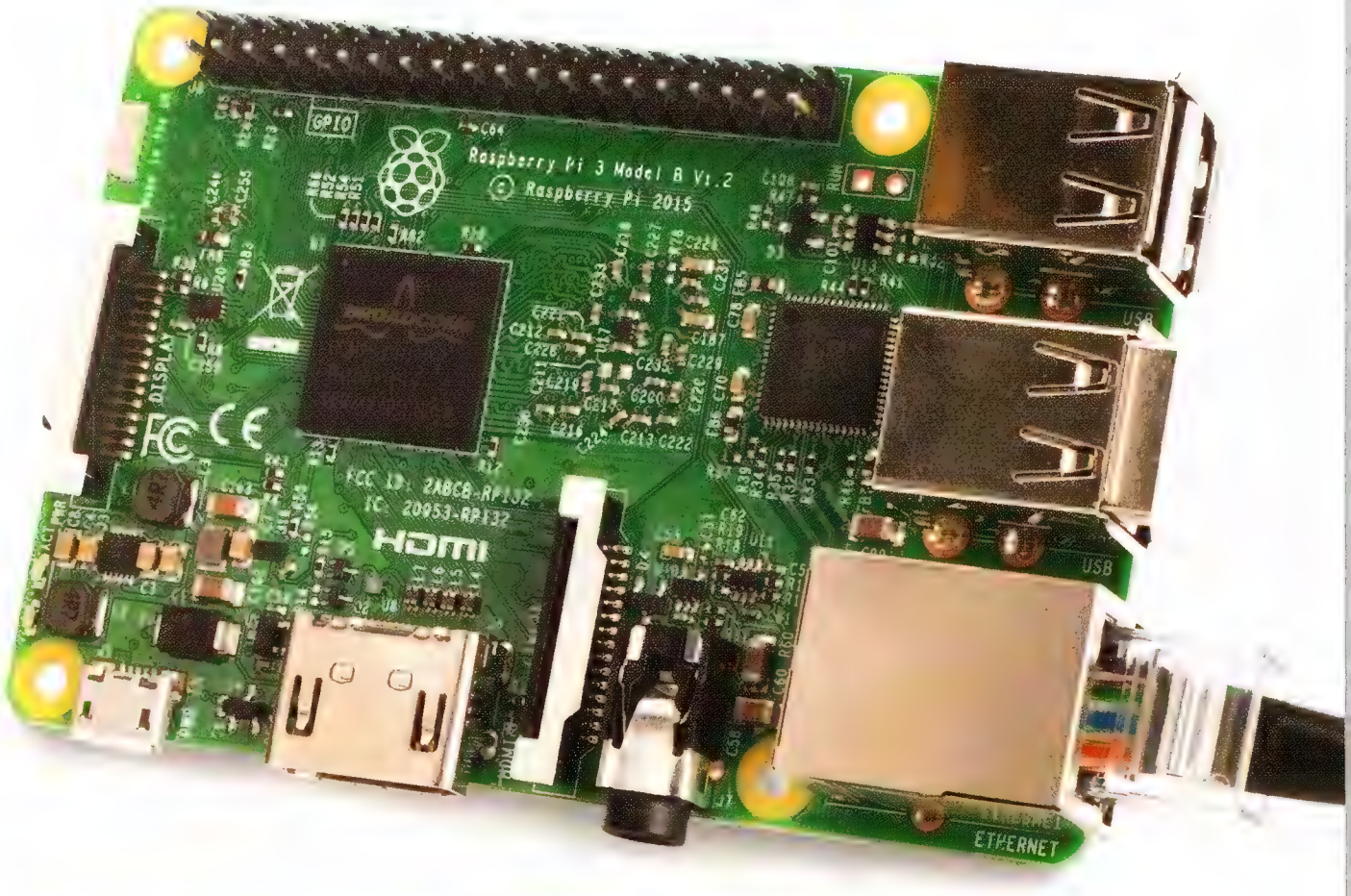
5 DEPLOY MISSING USB DRIVERS

At this point, our OpenWRT instance is connected to the internet at large. This allows opkg to download required packages — connect yourself using SSH and the IP address determined by NMAP, and proceed to downloading the packets listed in the code accompanying this step. When all modules are installed, entering dmesg will show that the ASIX Ethernet interface has been detected and configured as interface eth1 according to the figure.

```
  opkg update
  opkg install kmod-usb2
usbutils kmod-usb-core
  opkg install kmod-usb-net
kmod-usb-net-asix
```

6 CONNECT

Even though dongles based on the ASIX AX88772B are quite common, not being able to procure one does not totally condemn your experiment to



"If your router contains a USB port, it can — in theory — be used to access various external USB storage media. Sadly, the required packages are not provided out of the box."

failure. Connect the USB to LAN bridge to a Raspberry Pi running Raspbian and enter the lsmod command. It will provide you with information about the driver modules being used, which can then be tracked down on OpenWRT. Googling "<chipset> openwrt" or "<productname> openwrt" can also yield some useful results.

7 OPEN THE WEB INTERFACE

After completing the kernel configuration process, our new interface is ready and awaits the deployment of a configuration. As the OpenWRT image provided for the Raspberry Pi restricts us to vi (nano will not install), configuration is best done via the web interface we touched on earlier. It can be accessed by pointing your browser at the URL of the router; log-in can be accomplished via the root password used on the command line.

8 LET'S GET ROUTING

The newly-created USB Ethernet port will be used to connect clients: you can connect either a 'dumb switch' or a single device. In both cases, a DHCP server is needed in order to provide IP addresses to the clients.

Click the 'Add new interface' button, and name the new interface 'Clients'. Next, select the protocol to be Static address and select the newly created interface eth1. Next, scroll to the bottom of the window and click the Setup DHCP Server button in order to fully populate the form.

With that, the IPv4 address and broadcast fields must be set up. Finally, click 'Save & Apply' in order to commit the changes to the network stack. Next, open up the network configuration once again and set the Firewall Settings to the firewall zone LAN.

9 REARRANGE THE INTERFACES

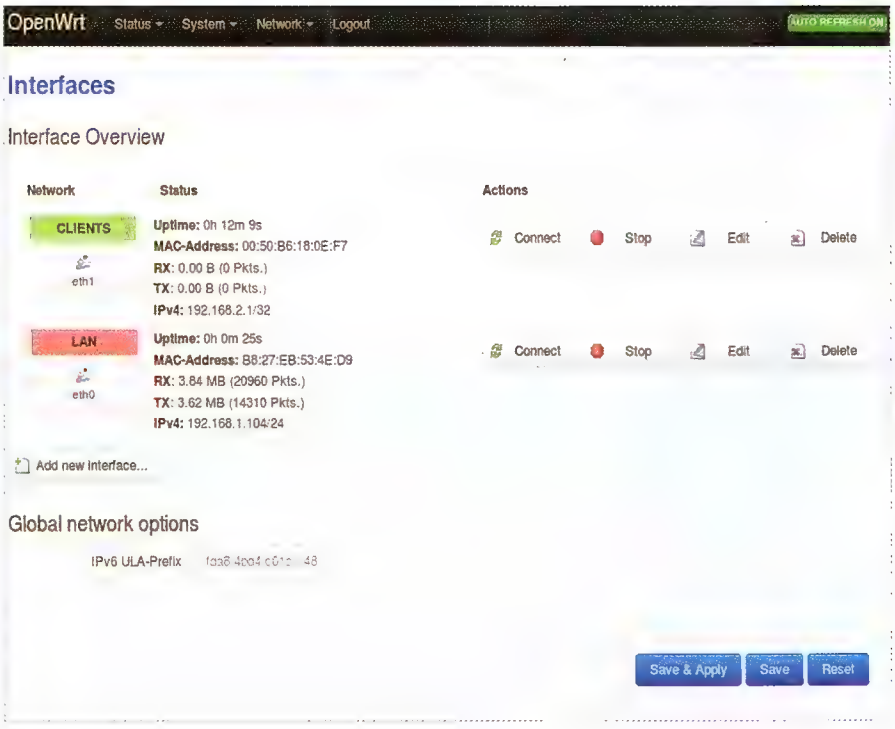
By default, the LAN interface is bridged, however, this is not necessary. To change this, open its properties, select the Physical Settings tab and unselect the Bridge interfaces checkpoint. Next, open the Firewall settings tab and assign the WAN zone.

Finally, another click on 'Save & Apply' makes OpenWRT assign the attributes leading to the configuration shown in the image above.

10 FIREWALL AHOY!

From this point onward, attempting to interact with the LuCI frontend from 'outside' of the network will lead to 'Unable to connect' errors — by default, remote configuration is not allowed to make attacks on OpenWRT more difficult.

Solve this problem by disconnecting the workstation from the 'outer router', and connect to the Raspberry Pi's USB network interface instead. Then perform an ifconfig command and connect to the standard gateway in order to open the LuCI interface once again. Should you find yourself in the situation that no IP adress is



assigned to the workstation, reboot the process computer and reconnect the ethernet cable.

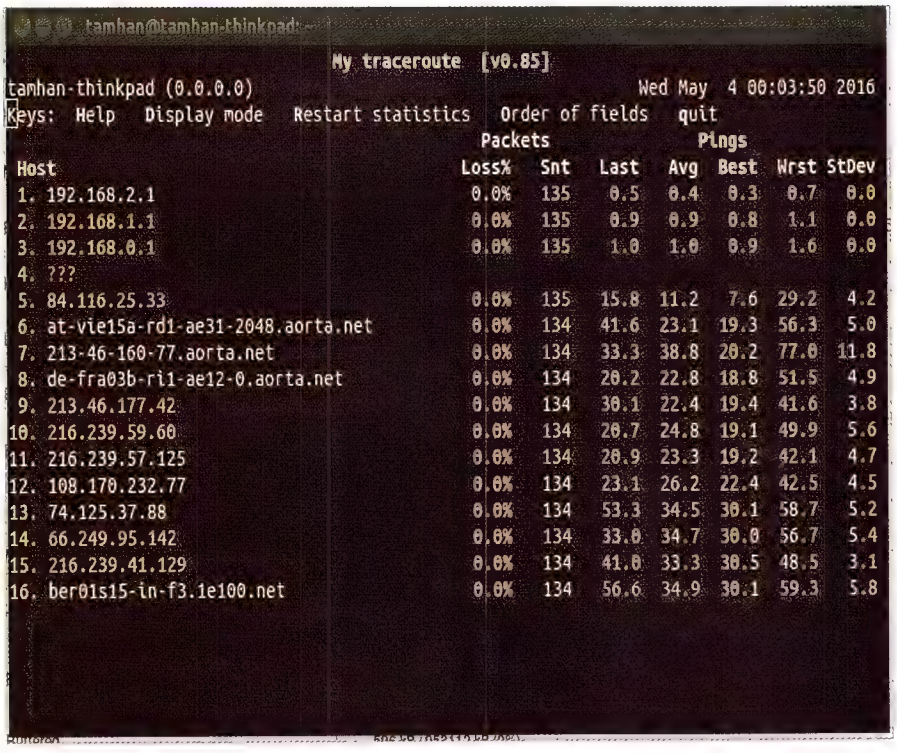
```
tamhan@tamhan-thinkpad:~$
ifconfig eth0

Link encap:Ethernet HWaddr
 28:d2:44:24:4d:eb

 inet addr:192.168.2.157
Bcast:192.168.2.255
 Mask:255.255.255.0
 inet6 addr:
fe80::2ad2:44ff:fe24:4deb/64
 Scope:Link
```

11 TEST THE PRESENCE OF THE ROUTER

As long as all other network connections are disabled, the workstation can connect to the internet only via the RPi. Enter "mtr www.google.com" in a command line in order to generate the tree structure shown in the figure below – from a latency point of view, our OpenWRT access point looks quite good when operating under light load.



12 ANALYSE THE NETWORK STATUS

Generating live diagrams with further information about the state of the router is an interesting feature. Open LuCI and select 'Status > Realtime graph' in order to open a set of diagrams telling you more about CPU and network loads.

13 DEPLOY FILE SYSTEM SUPPORT

If your router contains a USB port, it can – in theory – be used to access various external USB storage media. Sadly, the required packages are not provided out of the box. This problem can be remedied by deploying the following packages via opkg:

```
kmod-usb-storage required
kmod-usb-storage-extras
block-mount
kmod-scsi-core
```

In addition to that, a kmod-fs-* package containing the drivers for the file system is required. One small gotcha awaits all those who want to access FAT filesystems – the relevant package is named 'kmod-fs-msdos'.

14 LEARN MORE

OpenWRT can be used for a variety of topics not discussed here due to space constraints. The OpenWRT project team provides a set of step-by-step recipes at **wiki.openwrt.org/doc/howto/start** – if you feel like implementing something, check whether someone else has already walked the trek for you!

15 FIND SUPPORTED HARDWARE

Our current contraption – made up of a Raspberry Pi and a batch of peripherals – works well for evaluation purposes, but is not particularly well suited to practical deployments. Should you feel like finding a dedicated router, start out by looking at the compatibility list provided at **wiki.openwrt.org/toh/start**. Please be aware that router manufacturers tend to change their hardware frequently: in some cases, more than 12 revisions with completely different integrated circuits are known.

16 HARDCORE DEBUGGING

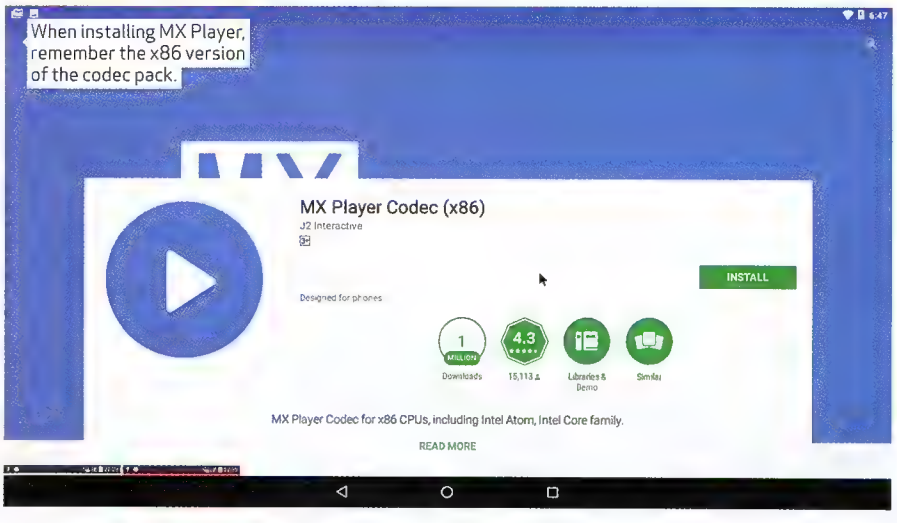
Should you lock yourself out of your OpenWRT router, fret not: if the memory is not soldered in, simply mount it with a cardreader of choice. Most, if not all, Linux distributions will display the contents of the file systems immediately – accessing some of the files requires that the file manager is run with root rights (sudo nautilus). ■

Get some Nougat in your PC

Don't wait to get Android 7.1.2 on your phone — install it on your PC instead! Darren Yates shows you how with the new 'Nougat' release candidate of Android-x86.

Unless you're prepared to drop some dollars on the latest phone – or you've just done so recently – the only other way to grab hold of the latest Android release is to get your developer's hat on, some Android Studio downloads and run a Nougat virtual machine. But thanks to a new release from Android-x86.org, you can now run Android 7.1.2/Nougat on your x86 hardware. What's more, it comes with root-access baked in, plus Google Apps (Gmail, Play Store) to run many of your favourite apps and games.

Angry Birds runs nicely on our test laptop with Nougat-x86 RC1


When installing MX Player, remember the x86 version of the codec pack.
MX Player Codec (x86)
J2 Interactive
INSTALL
Designed for phones
MX Player Codec for x86 CPUs, including Intel Atom, Intel Core family.
READ MORE

INSTALLING ON REAL HARDWARE

We've been playing around with this new release for a bit and found two different methods of operation that work – creating an Android virtual machine (VM), which runs Android as an app on top of your Windows PC, plus installing Android on actual hardware. The VM option is less messy (and potentially cheaper), but in our view it's not as fulfilling an experience, particularly on gaming and video. It's still a worthwhile option for everything else, but to get the best results, we've decided this month to look at installing it on x86 hardware.

SOFTWARE YOU'LL NEED

In terms of software, we'll assume you have access to a Windows PC somewhere about and can grab UNetbootin (**unetbootin.github.io**). This free tool takes 'live' distro ISO images and turns them into bootable USB flash drives.

Next, you'll need the Android 7.1.2/Nougat RC1 ISO image, which is available free from **Android-x86.org** or OSDN (**tinyurl.com/y824wzeh**). It's only a first 'release candidate', so consider it better than 'beta', but not 'retail' – that means expect to find the odd glitch or feature not working fully. We recommend the 32-bit 'android-x86-7.1-rc1.iso' download, unless you're sure you've got 64-bit hardware to throw at it, in which case, grab the 'android-x86_64-7.1-rc1.iso' file instead.

HARDWARE REQUIREMENTS

As for hardware, you'll need a USB flash drive. Regardless of the Android ISO image you opt for, they're all less than 1GB in size (the 32-bit ISO image is about 680MB), so any USB flash drive that's 1GB or larger should do the trick – great for those freebie flash drives floating around in your drawer!

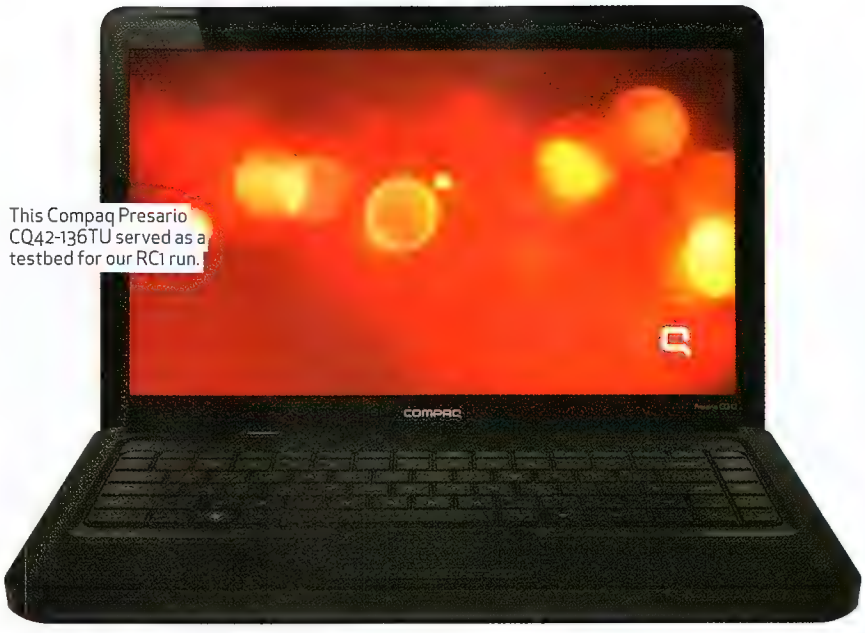
Finally, you'll need something to install it on. Personally, I don't recommend dual-booting this release on your existing PC, so it's the opportunity to resurrect that old laptop you're using to hold up your shelves. I have a 2010-era Compaq Presario CQ42-136TU laptop for just such occasions – it's a 1.9GHz dual-core Intel Celeron T3100 with 2GB of RAM and a 250GB hard drive running Windows 7. It's old and seen better days, but for Android, it's perfect.

1 REPLACE THE HARD DRIVE

Given that warning about dual-booting, plus the fact I don't much like obliterating a working hard drive install of Windows, I'd suggest replacing the laptop's original hard drive with an old smallish SSD instead. There are a couple of reasons for doing this. First, I reckon Android runs better off an SSD and just seems a bit more responsive, but second, if you find Android isn't your cup of tea, you can replace the SSD with your original laptop hard drive again and everything is back to the way it was.

We replaced the original 250GB hard drive in this Compaq Presario

laptop with an old 64GB OCZ Vertex2 SSD. Would we purchase a new SSD to try Nougat out? In a word, no. Being a 'release candidate', we found in our experience a sufficient number of things just not quite right yet – that's why using your old hardware would be a better way to go. Of course, if you only have a spare hard drive you don't mind erasing, that's better than nothing.


This Compaq Presario CQ42-136TU served as a testbed for our RC1 run.

2 CREATING THE ANDROID USB INSTALLER

Android-x86 is designed as a 'live' distro, meaning you can create a ready-to-go USB flash drive or CD and preview the OS live on your PC without installing anything. In that regard, it's similar to many Linux distros like Ubuntu. But the same flash drive or CD can also install the OS onto a computer and since you can't get the full experience without persistent storage (which you don't get with a preview), we think a proper install is best.

To create an Android USB installer, plug your USB flash drive into your Windows PC and make sure you copy off any files you want to keep – there won't be anything left of them after we've finished this process. Once you're done, crack open UNetbootin. Towards the bottom-left of the app window, you'll see a radiobutton next to 'Diskimage' – click on it. Next, press the browse (...) button on the right and locate the Nougat ISO image file you downloaded before. Make sure you select the USB flash drive letter and, when you're ready, press the OK button and Nougat will install as a 'live' bootable distro on your flash drive.

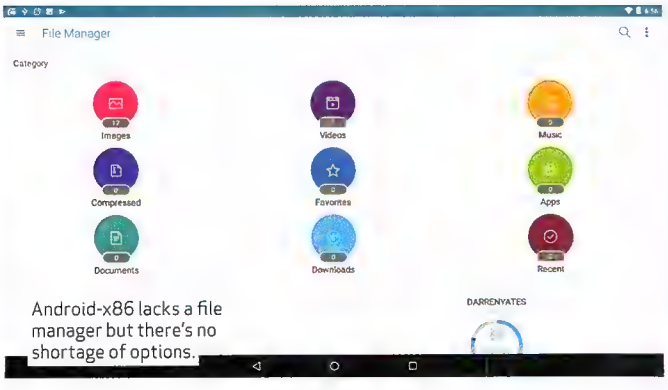
3 INSTALLING ON YOUR OLD LAPTOP

If you have your old laptop ready to go, plug your Nougat USB flash drive into a USB port, boot up the laptop and press whichever key sequence you need to bring up the boot options. Select to boot from the USB flash drive. Within a few seconds, you should get a blue text-based menu screen with a few choices. Scroll down to 'Installation - Install Android-x86 to harddisk' and press Enter. Follow these six steps for the rest:

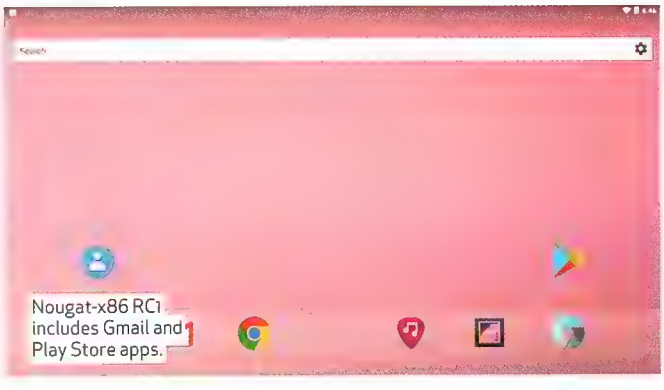
- A few seconds of whizzing command logs later, you should see a 'Choose Partition' screen with a few options. The first should be 'sda1' – that'll be your SSD or hard drive, 'sdb1' will be your USB flash drive. Ensure 'sda1' is selected and press Enter.
- Next, you'll need to choose a filesystem to format the drive with – select 'ext4' and press Enter. Note, this will erase everything on that drive and format it with the ext4 filesystem.
- After that, you need to install the GRUB boot loader, select Yes and press Enter.
- Now you'll be asked whether to make the '/system' folder read-write. Choose No and press Enter.
- Android will now write itself onto the laptop's drive and take about 30 seconds.
- If all goes well, you'll see a 'congratulations' window. Select 'Reboot', press Enter and remove the USB flash drive.

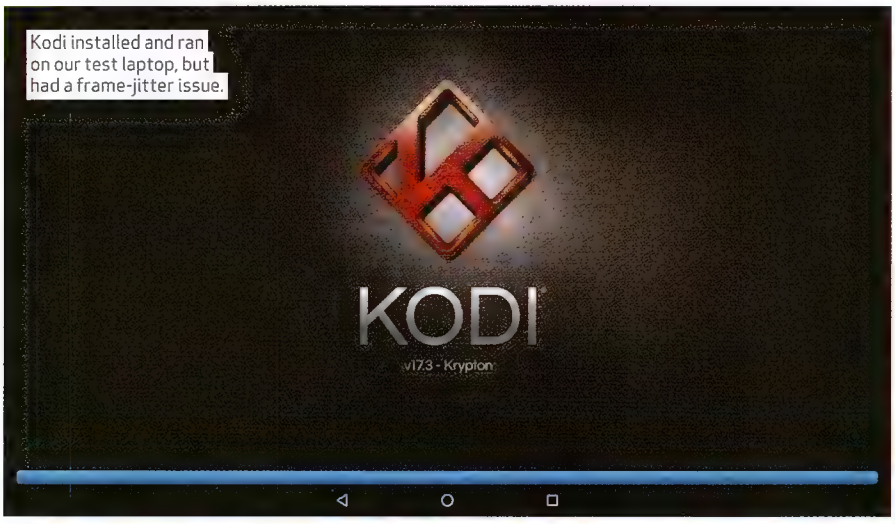
The one thing you'll notice is just how fast Android-x86 installation is. After doing this a few times, we were

This RC1 build features a recent version 4.9.31 of the Linux kernel.

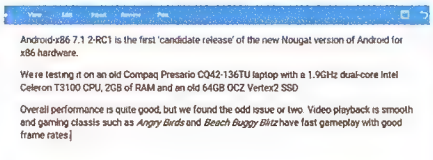


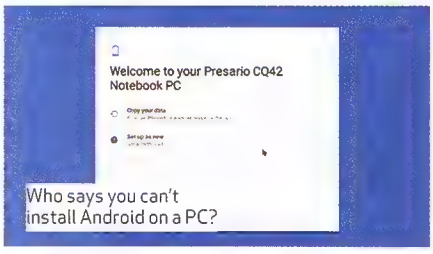
Android-x86 lacks a file manager but there's no shortage of options.


Nougat-x86 RC1 includes Gmail and Play Store apps.



Kodi installed and ran on our test laptop, but had a frame-jitter issue.

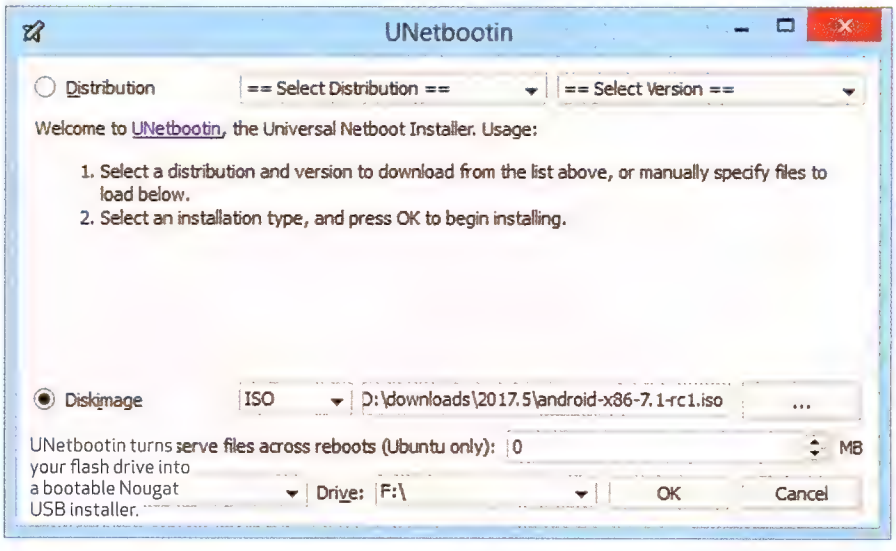

Kingsoft's WPS Office Suite covers the basics for zero cost.



Who says you can't install Android on a PC?

Critical Ops played well with frame rates in the low-40fps range

"The fact that RC1 comes with the four major Google Apps — Gmail, YouTube, Chrome and Play Store — means that, despite the fairly short apps list, you've got all the basics you need to operate."



able to get this process done in well under two minutes.

4 SETTING UP

Your laptop should now boot up into a black-and-white text menu showing 'Android-x86 7.1-rc1' as the first entry. If it doesn't automatically select it and launch, do so by pressing Enter. Once you see the big 'android' logo, you're on your way — from here, the setup procedure is the same as if you just bought yourself a new Android phone. You can create a new Gmail account specifically for testing, rather than install your real Gmail account if you prefer.

THREE OUT OF FOUR

The fact that RC1 comes with the four major Google Apps — Gmail, YouTube, Chrome and Play Store — means that, despite the fairly short apps list, you've got all the basics you need to operate. Of the four apps, Gmail, Chrome and the Play Store worked perfectly with no observable glitches. YouTube, on the other hand, was far more temperamental on our CQ42-136TU laptop.

The main problem we found was sound, but no vision — at least selectively. You could set the frame resolution to 720p for a particular clip on one occasion and see 720p video, then not on another. After burning through several hours looking for a solution, the only thoughts we could come up with was an issue with the app's clip location selection from YouTube servers or a problem negotiating the video codec selection when playback tries to begin.

While it was definitely temperamental, what was really interesting though is that this Nougat-RC1 version of YouTube seemed more optimised for our laptop than the latest 'r3' release of Android-x86 Marshmallow/6.0. The 6.0-r3 version of YouTube couldn't maintain a decent frame rate at more

than 360p (480 x 360-pixel) resolution on our CQ42-136TU laptop, yet this 7.1.2-RC1, when it worked, had no dramas at all with 720p (1,280 x 720-pixel) YouTube video at full frame rate. Your mileage may vary.

VIDEO PLAYBACK

Otherwise, we know this laptop was capable of playing back local 720p video and it worked well with MX Player – given RC1's decent built-in codec support and the MX Player codec pack, there shouldn't be too many files you can't play. We also installed the latest version of Kodi (17.3 Krypton) and while the user interface ran perfectly with no glitches, we had an odd frame-order jitter occur on all video files we tried, files that showed no issue when played with MX Player.

PERIPHERAL HARDWARE

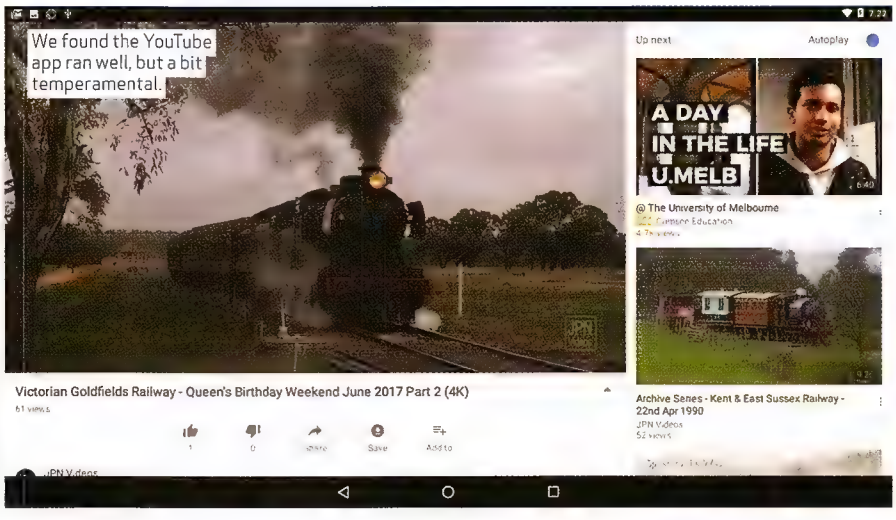
Out of the box, Wi-Fi was up and running, so too were the laptop's built-in webcam and audio. Keyboard volume control shortcuts for the audio also worked. We were able to connect up a USB microscope (with appropriate software) and even USB flash drives automatically mounted into the system. The real surprise was that provided you booted up with the optical disc in place, you could even read CD-ROM and DVD-ROM discs. You can't play DVD movies or audio CDs, at least not with the internal drive, but there are apps now available that claim to offer audio CD playback via external USB drives (we weren't able to test this).

WATCH OUT FOR...

The most troublesome issue we faced occurred on three separate occasions and that was an unrecoverable boot-loop. It happened once when we used the power button-reset option. It also happened again after we allowed Root Browser file manager to gain root-access to install Linux utilities. It happened a third time when downloading a game from Google Play. We don't think these actions were the root cause, but we're also not sure what the problem was, other than maybe some form of filesystem mounting issue.

We did find a solution that fixed it without losing any files, but only temporarily. What we did was follow the mini six-step install guide in Step 3 back over the page, but this time, when we got to selecting a filesystem, we chose 'do not format' instead of 'ext4'. We installed GRUB as before and followed the rest of the steps, even to writing the Nougat ISO to the drive. When we rebooted, the drive came up as normal with all of the previously installed apps. However, on the following reboot, the system boot-looped again.

The first boot after installation should present the standard welcome screen.
ENGLISH (UNITED STATES)
Emergency
Vision Settings


We found the YouTube app ran well, but a bit temperamental.
Up next
Autoplay
A DAY IN THE LIFE U.MELB
@ The University of Melbourne
Victorian Goldfields Railway - Queen's Birthday Weekend June 2017 Part 2 (4K)
Archive Series - Kent & East Sussex Railway - 22nd Apr 1990

Another thing, you'll want to get hold of a decent screen rotation-lock app – it only takes one app switching into portrait mode and turning your screen sideways to get sick of it. The best app we've found for this is Set Orientation, it's free on Google Play. Launch it, set it to 'landscape', problem solved.

To be fair, Andfroid-x86 7.1.2-RC1 is called a 'release candidate' for a reason and despite the glitches, we still think it shows lots of potential.

GAMING

We tested Nougat/7.1.2 with gaming classics *Beach Buggy Blitz* and *Angry Birds* – both worked a treat on our laptop, offering fast gameplay and decent frame rates. On the other hand, *Candy Crush Saga* wouldn't start. But we also had success with more recent releases including *Critical Ops*, which can be operated by mouse. *Critical Ops*' built-in frame rate counter at top-right of screen showed frame rates of between 42 and 59fps at native 1,366 x 768p resolution, which isn't bad for a dual-core Celeron and integrated Intel GMA4500 graphics.

In the end, though, Android gaming on a laptop mostly requires support for gamepads and keyboards, plus the ability to either run code natively on x86 hardware or use Android's App Compatibility option in Settings.

CONCLUSIONS

If you've got an old laptop floating around and a spare SSD you're not using, it won't cost you anything to try this new version of Android-x86. As we've said, we found this RC1 release well-named, with a few issues that still need to be addressed before Nougat-x86 is really ready for prime-time, including that bootloop issue. That said, most things are fixable and we think this RC1 is the most advanced RC1 we've seen from the Android-x86 team – it feels fast, responsive and more things work out-of-the-box than we've experienced previously.

Bottom line is: while your mileage will probably vary, from what we've seen so far, Nougat-x86 has the potential to be an excellent way of bringing your old x86 hardware out of retirement and turning it into the very latest Android experience. We eagerly await the next release.

Make a digital voice-powered oscilloscope

Add a microphone module and OLED panel to your Arduino Nano and make a voice-powered oscilloscope. Darren Yates explains how.

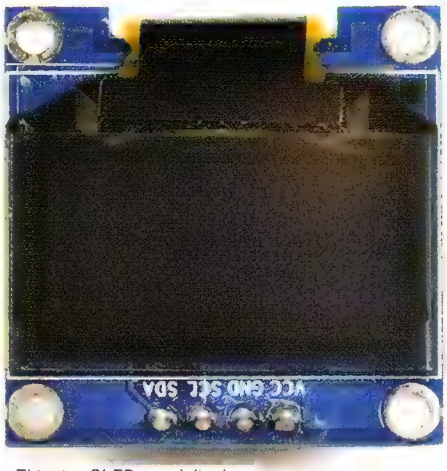
The fact we can hear changes in air pressure and recognise different frequencies is fascinating. But what does sound look like? What can we see by looking at it? It's likely a question asked in the early 1920s when the first reliable cathode-ray tubes were developed. For the first time, scientists could watch how sound captured by a carbon microphone caused variations in voltage that could be seen on a new cathode-ray oscilloscope or 'CRO'. This month, we're replicating that experiment with modern-day components, combining an Arduino Nano, a 128 x 64-pixel OLED panel and a low-cost audio microphone module to create a digital voice-operated oscilloscope.

ADDING A MIC TO ARDUINO

It's probably been one of the most requested topics for us to cover, how to add a microphone to an Arduino. It's tricky for a number of reasons, but mostly comes down to whether you want to just detect sound or have access to actual audio. You can buy microphone modules to do either task, but you have to choose carefully – that's because sound detection modules deliver a digital '1 or 0' voltage output, whereas a genuine audio microphone module must give you an analog audio output. We spent all of $1.50 purchasing a MAX9812 microphone module from eBay, a complete mic setup with a fixed 20dB amplification factor or 'gain' amplifier and a small electret mic on top. It requires 5VDC power, which you can take from the Arduino board.

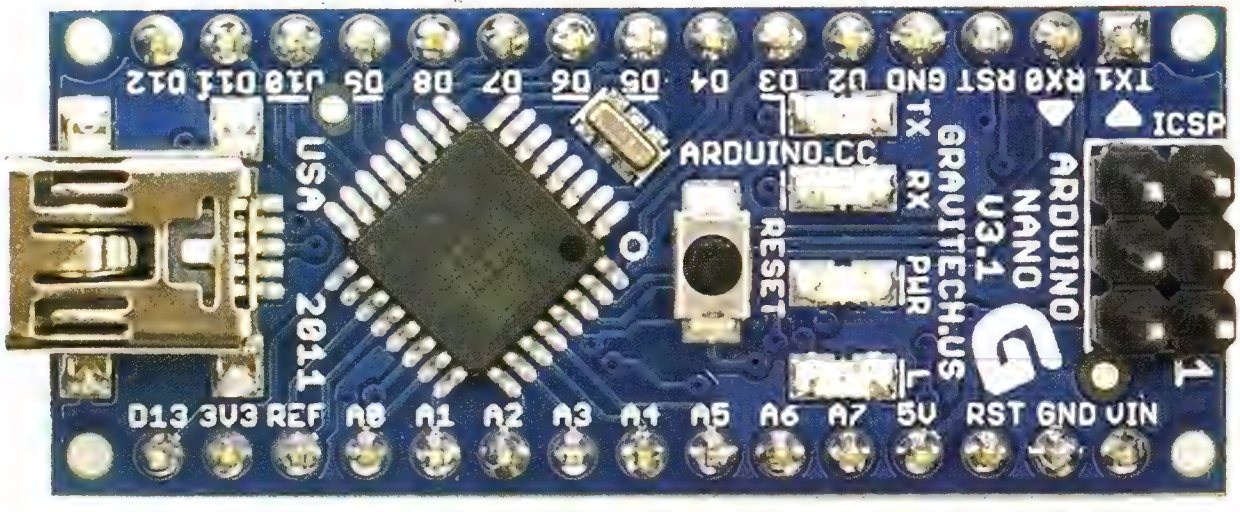
To feed the module's audio output into an Arduino board, you have to hook it up to one of the Arduino's analog-to-digital converter (ADC) inputs. But there's a catch – you must also bias the ADC input to half-supply voltage. The ADC inputs of the Arduino Nano are designed to turn DC voltage into a digital number between 0 and 1,023. But audio from the MAX9812 output is AC voltage only. To ensure we capture the full swing of that AC voltage, we need to set or 'bias' the ADC input to half the supply voltage (half of 5VDC is 2.5VDC). This way, the audio signal can swing equally above and below this 'bias voltage' and we'll capture the full range of that signal.

The easiest way to create the bias voltage is to connect up two 10kohm resistors as a voltage divider connected between a 5VDC supply rail and ground (0V). Ohm's Law ensures the DC voltage at the junction of the two resistors is 2.5VDC and we connect this to the ADC input A0, along with the microphone module audio output. If you don't do this, you'll lose the negative-going half of each audio cycle since the ADC input can't go any lower than zero-volts.

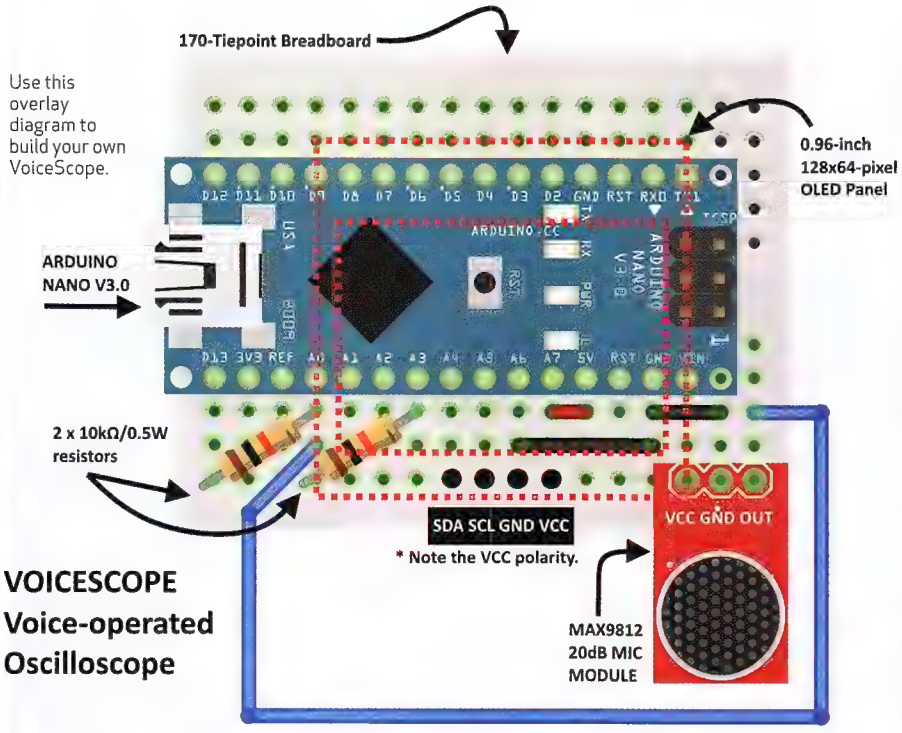


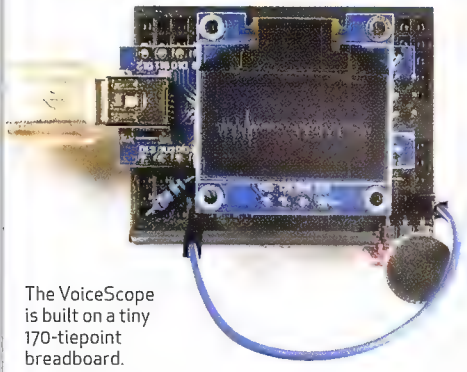
This tiny OLED panel displays the oscilloscope trace.

This MAX9812 microphone module will set you back $1.50 on eBay.



The Arduino Nano is the brains behind our VoiceScope.





The VoiceScope is built on a tiny 170-tiepoint breadboard.

We cheat and use analog input A3 as a digital output to supply 5VDC power – the microphone needs little current, so this works just fine.

HOW ANALOG-TO-DIGITAL CONVERSION WORKS

ADC samples are created by comparing the ADC input voltage with a reference voltage. The default on the Arduino Nano is 5VDC for standard 5V/USB-powered boards and the ADC has a 10-bit range, giving a digital value of between 0 and 1,023. So if the input voltage is 2.5VDC (ie, half the reference voltage), the ADC will create a digital sample of 512 (half the 1,024 range) and if it's 1.25V (a quarter of Vref), the ADC sample will be 256 (a quarter of 1,024). This continues for every sample. The actual conversion process is known as 'successive approximation analog to digital conversion' and you'll find at least one ADC in every smartphone turning your voice into digital phone calls.

TURNING SOUND INTO VISION

Now for the fun bit – we need to capture audio samples at a set rate, so that we can reproduce the waveform on the display. The OLED panel is 128 pixels wide, so we set aside a 128-element byte array buffer called 'buf'. We then capture 128 samples of audio and store those samples in the buffer. As soon as that last sample is captured, we display each sample on the OLED panel set as a standard X-Y Cartesian plot, where the Y-axis corresponds to each sample value, representing the voltage on the ADC input at time of sampling. As soon as the last pixel is drawn, we grab the next round of 128 samples and display those. With a sample rate of 22,050Hz, it takes just 5.8 milliseconds to grab 128 samples and around another 15 milliseconds or so to display them on the OLED panel. That means each pass or 'sweep' takes around 20 milliseconds, giving us a visual frame rate of roughly 50 frames per second or 50Hz.

WATCH IT ON OLED

You can pick up a 0.96-inch 128 x 64p OLED panel for around $5 on eBay but make sure you get the four-pin version supporting the I2C (inter-integrated circuit) bus. And most importantly, if you're following our overlay diagram, make sure you watch the VCC and GND pin polarity. The panel version we've used has the VCC pin on the outside – there are older versions with these two pins swapped. Plug an older module in with the voltage pins reversed and you'll blow it up, so be very careful.

WATCH DIFFERENT SOUNDS

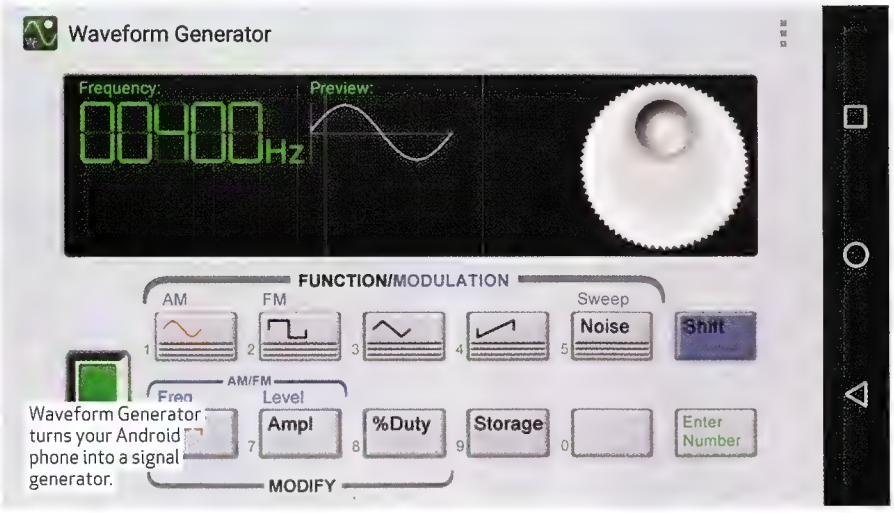
If you have an Android phone, head to Google Play, download Waveform Generator (**tinyurl.com/yddv7una**) and place your phone's speaker near the microphone. Press the power button, change the frequency and see what effect that has on the display.

Unfortunately, 20dB isn't really enough gain to give a decent visual output (you really need nearer to 40dB), so we've increased the gain in code to boost the sample level, a bit like using digital zoom on your phone camera – unfortunately, this also boosts the noise, which is why the oscilloscope line or 'trace' isn't dead-flat with no input.

GIVE IT A GO

You'll find the source code on our website at **apcmag.com/magstuff**. Download it, unzip the file and copy the contents of the 'libraries' subfolder into the same of your Arduino IDE (get this free from **arduino.cc/downloads**). Open the voicescope.ino source code, flash it to your Arduino Nano board, build the project and away you go.

It certainly won't worry professional oscilloscope makers like Tektronix, but for a $10 oscilloscope, our VoiceScope follows the same principles as the big models. It'd even make a great science experiment, so why not give it a go! ■

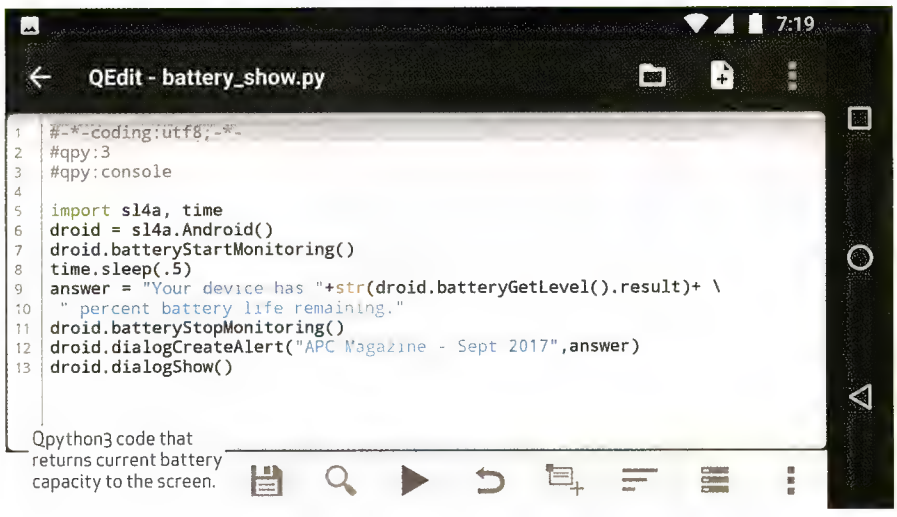


Waveform Generator turns your Android phone into a signal generator.

Coding Python... on Android!

Use your Python skills to create apps on your Android device, including speech recognition and text-to-speech. Darren Yates explains how.

Normally to build Android apps, you'd either crack open the official Android Studio integrated development environment (IDE) and create those apps using the Java programming language, or you'd use a cross-platform development environment such as Xamarin and code in Microsoft's C# language. But thanks to some clever software, you can also create basic apps for your Android smartphone or tablet using Python.



Qpython3 code that returns current battery capacity to the screen.

QPYTHON3

QPython is a free Python IDE available on Google Play that allows you to create Python projects and scripts directly on your Android device. Think of it as similar to the standard Python IDLE editor we've been using over the past year, but with a few more tricks. It's available as two versions: QPython, which supports Python 2, and QPython3 for Python 3 code.

Like the IDLE app, QPython allows you to create standard console apps using standard Python code. Want to accept user input from the standard device keyboard? Just use the same input() statement we've always used. What's more, it uses 'standard input', which means it'll accept input from whichever keyboard you're using, whether that's the soft Android screen-based keyboard or an external one. You print to the console using the normal print() statement, too. In fact, if you've been with us for a while, you'll find a good chunk of the code we've covered should work on QPython3.

But thanks to an extra layer originally developed by Google staffers called 'Scripting Layer for Android' (SL4A), QPython3 can also interact with Android device services, like Bluetooth wireless, on-board sensors, Android-style dialog boxes, even use Android's Text-to-Speech (TTS) and speech recognition features.

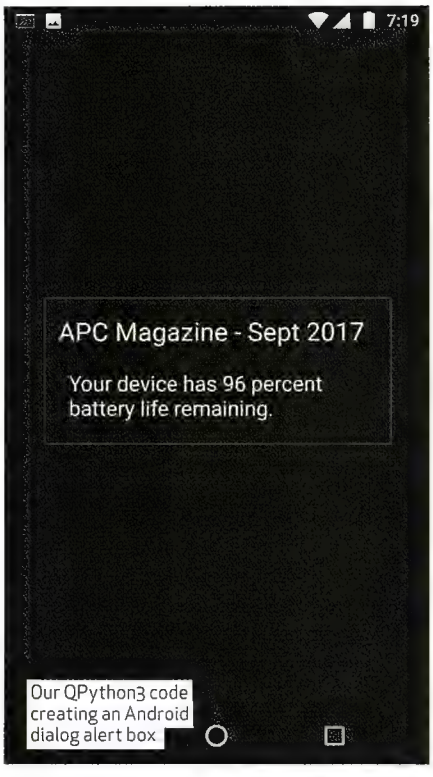
The beauty of QPython is that you're no longer tied to your laptop or PC – you've got a Python coding machine right there in your pocket.

ANDROID OS SUPPORT

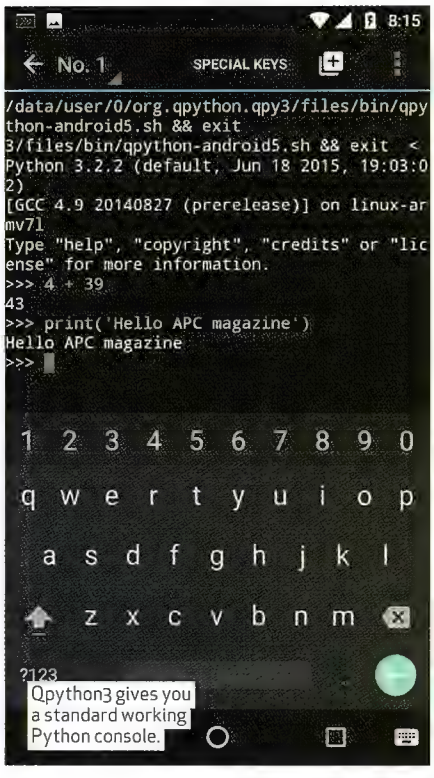
QPython supports any version of Android starting from Gingerbread/2.3 and works equally well on tablets and smartphones. You'll find it free on Google Play and it only needs 12MB or so of storage. You can also find more information about it at **qpython.org**. We've tested it on a range of devices, from a budget ZTE B816 dual-core/Android 4.4 phone I bought on special for $19 at Coles, to a new Motorola Moto G5 with eight-core CPU and Android 7.0, and it worked a treat.

SL4A

It began life as a general-purpose scripting layer to enable languages like Python and Ruby to connect to many of Android's application programming interfaces (APIs), but even though SL4A is no longer actively being developed, a version has been 'forked' into QPython. The SL4A code itself is built on Java, but you wouldn't know it – SL4A is easy to use and you can make simple, fun Android apps in just a few lines of Python code.



Our QPython3 code creating an Android dialog alert box



Qpython3 gives you a standard working Python console.

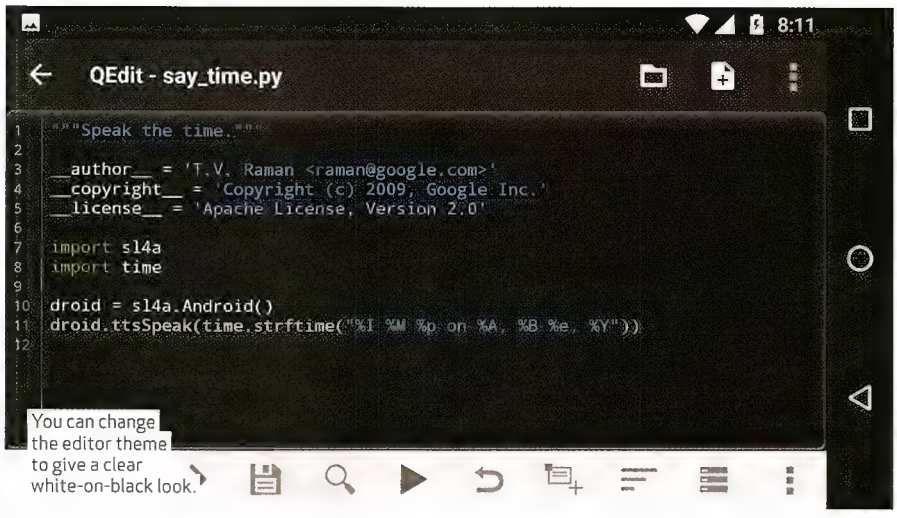
TEXT TO SPEECH

Tapping into Android's text-to-speech (TTS) engine is an easy way to impress friends with your coding skills. Install QPython3 on your Android device, launch the app and from the main menu, select 'programs', scroll down and open up 'speak.py'.

Apart from the licence code at the top, the actual app contains just four lines of code:

```
import sl4a
droid = sl4a.Android()
message = droid.
dialogGetInput('TTS', 'What
would you like to say?').result
droid.ttsSpeak(message)
```

The first line imports the SL4A module in the same way you would Python's random or time modules. Next, you create an SL4A Android object called 'droid'. In the third line, you create an Android dialog box using the dialogGetInput() function that asks the user to type in a text message. This function has two parameters – the first parameter ('TTS') is the box heading and the second ('What would you like to say?') is the message prompt to the user. The text the user types in is returned in the function's 'result' variable and its then stored in a variable called 'message'. The final code line fires up Android's TTS engine, sending to it the text stored in the 'message' variable. You might have a delay of a second or two the first time you run the code, but after that, you'll hear the dulcet tones of your Android device speaking the text entered.


8:11
QEdit - say_time.py
"""Speak the time."""
__author__ = 'T.V. Raman <raman@google.com>'
__copyright__ = 'Copyright (c) 2009, Google Inc.'
__license__ = 'Apache License, Version 2.0'
import sl4a
import time
droid = sl4a.Android()
droid.ttsSpeak(time.strftime("%I %M %p on %A, %B %e, %Y"))
You can change the editor theme to give a clear white-on-black look.

For just four lines of code, it's hard not to be impressed and from what you see, it's all done using Python.

TAKE A PHOTO

If four lines of code is too many, how about taking a photo with your Android device in just three? In the main menu, select 'programs' and open up 'take_picture.py'. The first two lines again import the SL4A module and create an Android object called 'droid'.

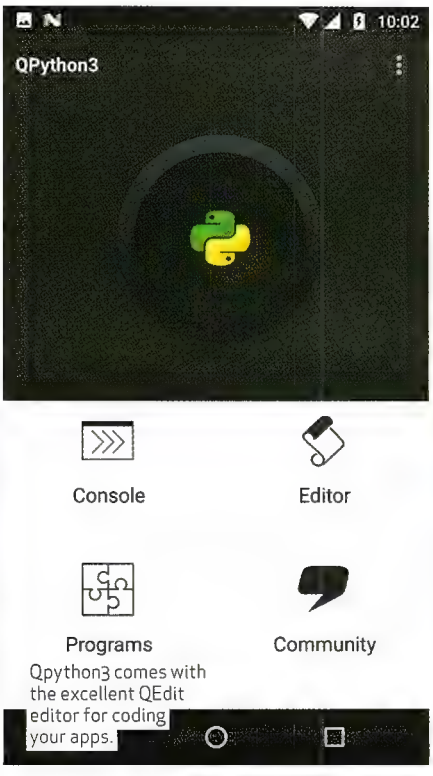
The third line launches the Android device's default camera app:

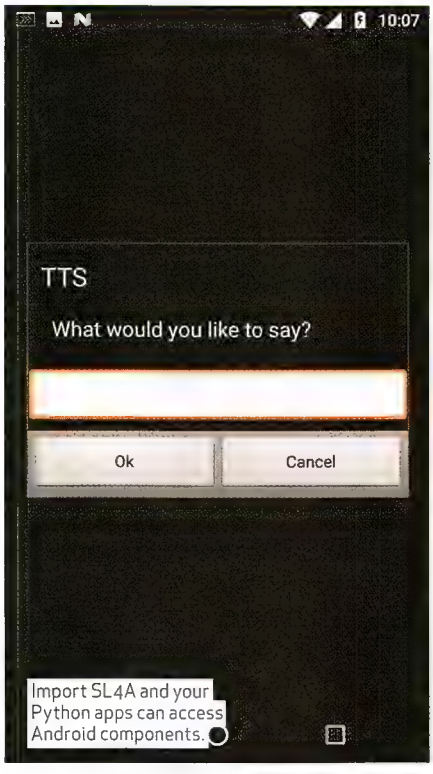
```
droid.cameraInteractive
CapturePicture('/sdcard/
qpython.jpg')
```

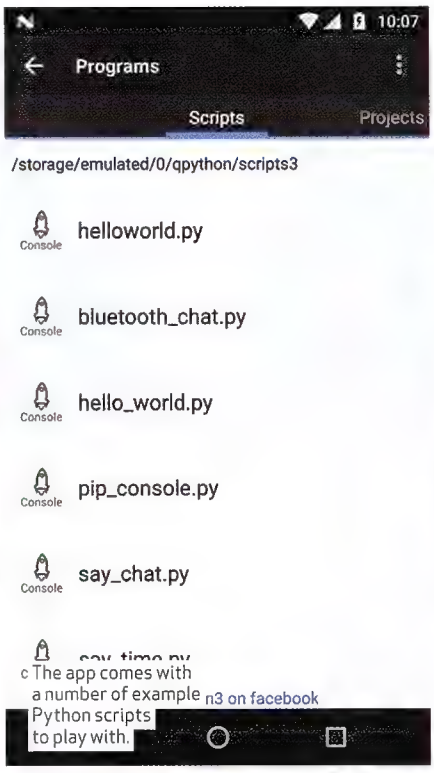
It allows the user to snap a picture and auto-saves it to the path '/sdcard/qpython.jpg'.

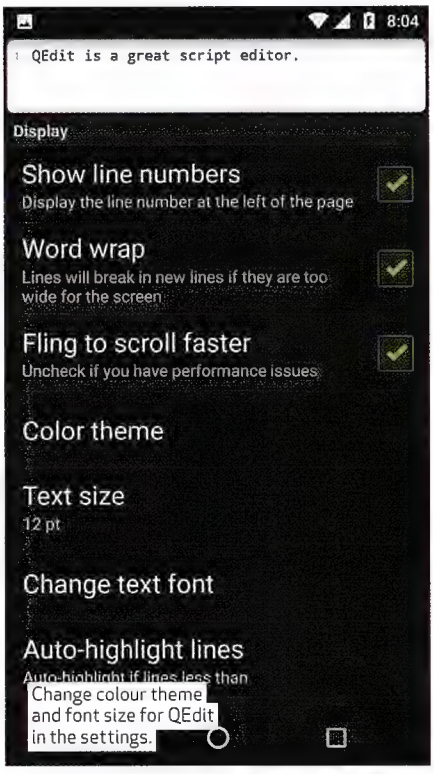
If you'd prefer something that's completely automated, you can have

> "QPython is a free Python IDE available on Google Play that allows you to create Python projects and scripts directly on your Android device."








8:04
QEdit is a great script editor.
Display
Show line numbers
Display the line number at the left of the page
Word wrap
Lines will break in new lines if they are too wide for the screen
Fling to scroll faster
Uncheck if you have performance issues
Color theme
Text size
12 pt
Change text font
Auto-highlight lines
Change colour theme and font size for QEdit in the settings.

> "QPython3 isn't going to replace the need for a full-blown Python install on your PC, but then again, that's not really its purpose."

the Android device take the photo instead – just replace the above command with:

```
droid.cameraCapturePicture('/sdcard/qpython.jpg')
```

Both of these only work if the file 'qpython.jpg' doesn't exist already. If you want to create a time-lapse photography app, for example, you need to provide a mechanism that automatically increments the filename from, say, 'pic1' to 'pic2' to 'pic3' and so on. One simple way to do this is to use a for-loop and add the value of the loop-counting variable to the base filename – this way, the file-naming occurs automatically as each photo is taken.

SPEECH RECOGNITION

Using Android's TTS engine is one thing, but you can also go back the other way and use Android's speech recognition engine to turn spoken word into text. Or you can even go a step further and combine speech recognition and TTS together to have your device repeat what the user says. What blows my mind is that you can do this trick with just three lines of code:

```
import sl4a
droid = sl4a.Android()
droid.ttsSpeak("You said"+droid.recognizeSpeech().result)
```

Save it as 'yousaid.py'. Again, the first line imports the SL4A library, the second line creates an Android object link called 'droid'. The third line does the heavy lifting – functionally, it starts with the recognizeSpeech() function, which launches Android's speech recognition engine and waits for you to say something. It then returns the spoken words as a text string in the recognizeSpeech() function's 'result' variable. We add 'You said' to the front of the text string and send the whole thing to the TTS engine for your device to turn back into speech. For example, you say 'hello how are you' and the TTS engine says back to you 'you said hello how are you'.

SPEECH-TO-TEXT

If you'd rather just display the spoken words as a dialog box on your device, you can do that too:

```
import sl4a
droid = sl4a.Android()
droid.dialogCreateAlert("Here's what you said:",droid.recognizeSpeech().result)
droid.dialogShow()
```

The first two lines you should recognise by now. The third line creates an alert dialog box and has two parameters – the first is the heading, which will be 'Here's what you said:', the second is the main message text and that'll be whatever the speech recognition engine recognised the user said. The last line is easy to forget, but if you do, you won't see anything – it tells QPython/SL4A to display to dialog box. Again, we've tested these on a couple of devices and they all worked.

READ BATTERY LIFE

SL4A can also link into Android's Battery Manager API, which provides access to a heap of functions, including source power identification, current battery level remaining and more. Here's a quick app I've written that finds the current battery level and speaks it.

```
import sl4a, time
droid = sl4a.Android()
droid.batteryStartMonitoring()
time.sleep(0.5)
droid.ttsSpeak("Your device has "+droid.batteryGetLevel()+"percent remaining")
droid.batteryStopMonitoring()
```

The third line initialises battery

monitoring, but before you can read the battery level, you have to wait for a battery event – that takes around a quarter of a second to occur after initialising, so we wait half a second to be safe using the time.sleep(0.5) command. Next, we use batteryGetLevel() to grab the battery capacity as a percentage, returned as an integer. We add some extra text around it and send the lot to the TTS engine. Finally, we shut down the battery monitoring, so that we don't waste CPU clock cycles.

SL4A FUNCTIONS

The key to making the most of SL4A is to understand the various commands. Unfortunately, QPython's reference for SL4A functions could use a bit of work. For instance, the QPython wiki's SL4A section makes no mention of the camera or the speech functions we've used above. It does say don't expect to be able to access every Android API, but not much about which don't work.

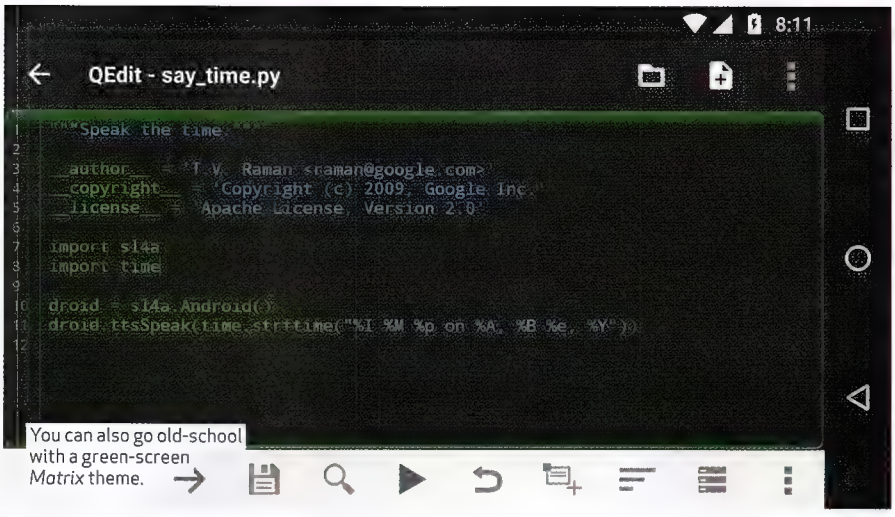
It might no longer be in development, but the original SL4A code is still available on GitHub with a complete list of API vectors or 'façades' that were developed. We're not quite sure just how many of these have been ported to the QPython3 version of SL4A, it'd be a case of 'try it and see'. So far, our strike rate has been 100% for this story, so it'd be worth you having a go yourself.

You'll find the original SL4A at **github.com/damonkohler/sl4a** and there's additional material available at **www.mithril.com.au/android/doc**. What impresses us about SL4A is the Android functionality you can access, including on-board sensors, media playback and recording, Wi-Fi and Bluetooth, Android's location manager, settings, preferences, even programmatically send SMSes, and that's on top of everything we've already looked at. Even if QPython only goes that far, that's still a huge amount of Android functionality you can tap into with your Python code.

ERROR LOGS

No matter what language you code in, there are always three types of errors – syntax errors, which are mostly incorrectly spelling of statements or required characters not in correct order; run-time errors, which usually show up as crashed programs; and then the most difficult ones, logical errors, that manifest themselves as apps not doing what you want them to do.

QPython provides error messages back to the console and if you're using SL4A functionality, those error messages will also include extra but brief Java run-time messages. Why? Because SL4A is coded in Java, the native language of Android. These messages will likely be enough to point you in the right direction of the fix, but they may not tell you the full story. For greater detail, QPython3 captures the full Java error messages and stores them in an error log in the root folder of your Android device's storage called 'qp3_last_err.log'.


8:11
QEdit - say_time.py
"""Speak the time."""
__author__ = 'T. V. Raman <raman@google.com>'
__copyright__ = 'Copyright (c) 2009, Google Inc.'
__license__ = 'Apache License, Version 2.0'
import sl4a
import time
droid = sl4a.Android()
droid.ttsSpeak(time.strftime("%I %M %p on %A, %B %e, %Y"))
You can also go old-school with a green-screen *Matrix* theme.

The error log file begins with a raft of ID data for various aspects of your Android device, the last of these appear as 'display', 'model' and 'device'. Straight after the 'device' ID, you'll find the actual Java-side error that caused your code to crash and the Java code location where it crashed. For example, a 'null object reference' error when trying to capture a photo may mean that there's a problem with the filename you've provided to the SL4A façade and QPython (or more accurately, Java) can't access the file.

Understanding error messages is an important skill to master, no matter what language you code in. The trick is to read the message(s) carefully, look back over your code and check with some examples to see how the command is meant to be used. Google can definitely be your friend here.

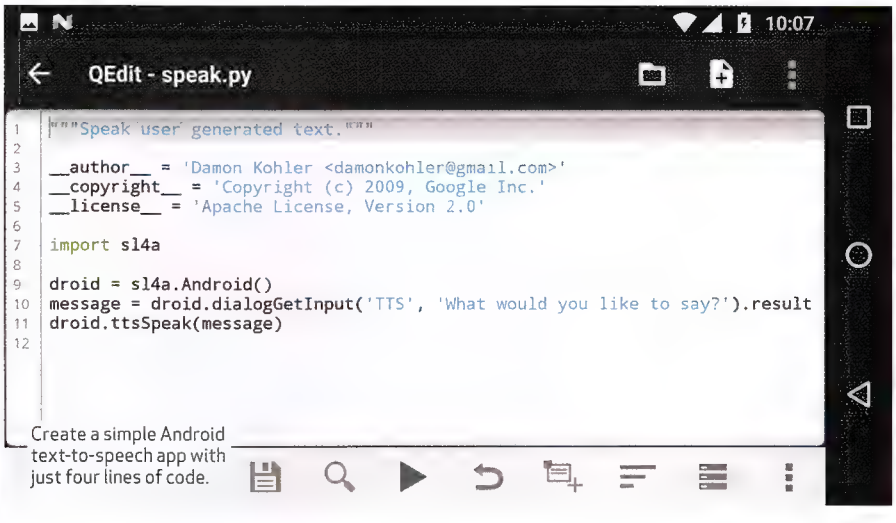
IPHONE OPTIONS?

If you're running an iOS ship instead, there are mobile Python options here as well – the 'Learn to Code with Python' app from Sololearn is well worth a look (it's free) and for Python development, Pythonista is probably as good as it gets (but it will cost you $15 and around 500MB of storage). In both cases, you'll need at least iOS 8.0 or later.

GIVE IT A GO

QPython3 isn't going to replace the need for a full-blown Python install on your PC, but then again, that's not really its purpose. Having the ability to tap into Android tech and create simple Android apps using nothing but Python is still a pretty neat trick.

But for me, the real value of QPython3 comes when you combine it with one of the growing number of pretty decent Python learning resources on Google Play. If you're stuck in the daily grind, commuting on public transport for an hour or two each day, why not make the most of the time by learning a new skill, particularly one that's in growing demand. The fact you can do all this on your Android phone – and for free – makes it an easy investment. ■


10:07
QEdit - speak.py
"""Speak user generated text."""
__author__ = 'Damon Kohler <damonkohler@gmail.com>'
__copyright__ = 'Copyright (c) 2009, Google Inc.'
__license__ = 'Apache License, Version 2.0'
import sl4a
droid = sl4a.Android()
message = droid.dialogGetInput('TTS', 'What would you like to say?').result
droid.ttsSpeak(message)
Create a simple Android text-to-speech app with just four lines of code.

PS4, PC | $29.95 | WWW.HOUSEMARQUE.COM

apc HOT PRODUCT

Nex Machina

A mindblowing twin-stick shooter from the genre's masters.

This is, at heart, a straightforward, game. The setup is as meat-and-potatoes as they come: the machines are trying to kill us, and it's humanity's job to fight back. But *Nex Machina* steadily becomes a more layered, complex experience the more you play.

For your first few tries, you're focusing almost exclusively on survival. You'll be aware that part of your job is to save the humans wandering around each level, but you'll also be happy to let them be harvested if a rescue attempt means putting yourself in harm's way. Though given the way these oafish survivors blunder around, constantly getting themselves in dreadful trouble, the machines surely can't want them for their brains.

As with any good twin-stick shooter, it's all about crowd control. The smaller machines swarm like insects, circular drop points alerting you to their imminent arrival so you can move out of the way. Bulky monstrosities make a beeline for the humans, while others are akin to static WMDs. Later variants include robot wheels that accelerate toward you before exploding, machines wielding stretchy electric whips, tanks firing payloads that wouldn't look out of place in a Cave shooter, and a hulking giant who keeps crawling toward you even after you've blasted his lower torso into a thick mist.

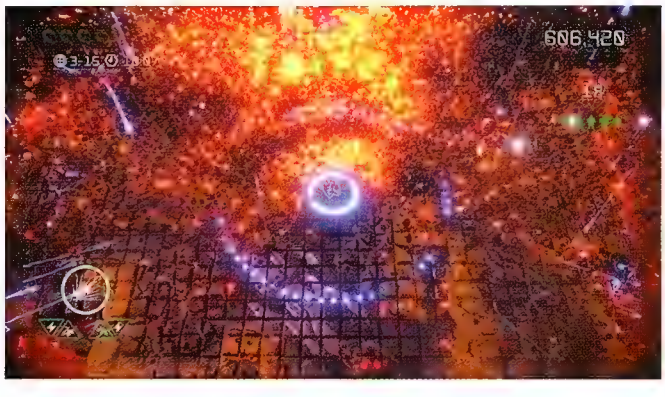
Despite those cascading cubes and the studio's fondness for lurid pyrotechnics, the action is easy to parse, even at such an unrelenting tempo.

Finding secrets is key to climbing the leaderboards; likewise, killing the three special types of machine within each world.

That's a lot to think about in a game that's keen to put you on the back foot and keep you there, and there's more. Those bumbling humans, you see, are more crucial than they may seem. Saving them is a good deed that doesn't go unrewarded, but how and when you rescue them is more vital still.

It's not a game where you're always moving back and around, corralling enemies as if rounding up herds of truculent robot sheep; rather, it's a game where you stare into death's gaping maw, dash toward it and then blow it up with a smart bomb. Or if you're really showing off, a sword.

Playing Nex Machina is its own reward.



Verdict

An accessible fighter with just enough depth that it'll hold your interest even if you're playing alone.

★★★★½

PC, PS4 | $53 | WWW.FINALFANTASYXIV.COM

Final Fantasy XIV: Stormblood

A triumph, thanks to endearing characters and a spectacular story.

The first time we set foot on the Azim Steppe, we felt a sense of adventure that we hadn't encountered in an MMO in a long time. We had come to this rural pocket of Othard, the new far-eastern continent in *Final Fantasy XIV: Stormblood*, to find an exiled prince and convince him to take up arms against the militaristic Garlean empire. It's a story that's almost as old as time, but *Stormblood* breathes new life into this familiar tale. This isn't just an expansion, it's a game in its own right.

Picking up directly where *FFXIV*'s last update, *Heavensward*, left off, *Stormblood* is a story of oppression and rebellion. At the centre of this tale is Lyse, an exiled Ala Mhigan who becomes the driving force in the movement to liberate her people from the tyrannical Garlean empire.

Lyse is one of the most endearing characters in all of *Final Fantasy*. Not only is she vibrant and charismatic, she's also devoid of the melodrama that drapes most *Final Fantasy* leads like a wet blanket. Even in her lowest moments, Lyse finds the strength to stand on her own.

The struggle to liberate Gyr Abania and Doma from the Garlean empire is laced with optimism embodied by courageous and confident characters. When tragedy strikes, it feels poignant and painful because it strikes a hard contrast from the upbeat tone of the story. The siege of Doma castle, for example, ends in a tragedy that, to us, felt just as gut-wrenching as Aeris' death in *Final Fantasy VII*.

My only major gripe is that this story is chopped up and sprinkled over the typical grind of an MMO. Compared to the main story quests, which are bursting with drama and exposition, the sidequests are largely forgettable vignettes of inconsequential characters. What's worse, they highlight just how limited *Final Fantasy XIV*'s quest design really is.

Just about every quest involves going to a place, clicking an object and then returning to the quest giver. The main story quests mask this problem with expert storytelling and boss fights, but sidequests offer very little beyond the experience points they reward.

Main quests also tour you through the new areas, and *Stormblood* continues *FFXIV*'s legacy of being the most visually stunning MMO we've ever played. Every dungeon, monster, boss and location feels exquisitely crafted and unique. And the already-brilliant soundtrack is one of the most memorable that we've ever heard.

The combat is also much improved thanks to a sweeping overhaul to the underlying rules and new 'job gauges'.

If you don't like *Final Fantasy XIV* for any reason, *Stormblood* is going to change your mind. From someone who is heavily invested in its world and characters, this is a triumph.

Steven Messner

Verdict

The story and boss fights aren't just exquisite by MMO standards, they rival the beloved Final Fantasy games.

★★★★½

apc HOT PRODUCT

Get Even

A strange genre hybrid by the *Painkiller: Hell & Damnation* studio.

PC, PS4 | $69.95
GETEVENGAME.COM

Poised delicately between psychological horror, walking simulator and first-person shooter, *Get Even* is a noble experiment by Farm 51, better known for *Deadfall Adventures* and *Painkiller*. As Cole Black, you awaken in a dilapidated old asylum only to find a young woman with a bomb strapped to her chest. While your efforts to save her have an initially ambiguous outcome, you'll soon be navigating a series of fairly bland environments in order to piece together the situation. Despite its aged graphics and clearly modest budget, *Get Even* is an atmospheric and compelling journey which, while incapable of perfecting any of the genres it dabbles in, is worth playing for its outlandish plot alone. Black spends most of his time scanning the environment for tell tale clues (most of which result in narrative exposition) and shooting the odd manic asylum inhabitant, and that rhythm is barely broken up as the game hurtles towards its close. A solid, ambitious effort for Farm 51, but one to experience with an open mind.

Shaun Prescott

★★★½☆

apc HOT PRODUCT

Arms

Go out on a limb.

SWITCH | $79.95 | WWW.ARMS.NINTENDO.COM

Despite setting you the simplest of goals — to knock your opponent out before they do the same to you — fighting games have steadily grown more complex since their arcade-era peak. At the very least, *Arms* acknowledges the need for a fighting game anyone can pick up quickly and have a good time with. That it's not quite like anything you've played before is a delightful bonus. Each of the ten combatants boasts a pair of stretchy upper limbs. With stages offering plenty of room to manoeuvre, and each character able to dash, jump and block, something as seemingly straightforward as landing a punch is harder than you might think. At times, it feels like those moments in an online FPS where two players circle one another. Since getting close to your opponent gives you less time to react, it's often best to leave a little distance, only closing the gap once they've committed to an attack that you've jumped or dodged. It's not the kind of fighting game where you need to worry about convoluted inputs or extensive combo strings. The weapons you attach to your character's arms give the combat much greater range and each fighter's unique ability gives you something extra to think about. *Arms* is a tremendous entry-level fighter that possesses enough depth to appeal to competitive players.

Chris Schilling

apc RECOMMENDS

PS4 | $69.95 | WWW.CRASHBANDICOOT.COM

Crash Bandicoot N. Sane Trilogy

Getting the bandicoot back together.

Having been absent from the video game world since 2010's *Crash Bandicoot Nitro Kart 2*, the return of Sony's original PlayStation mascot has been highly anticipated by fans of the lovable platforming marsupial.

With *Crash Bandicoot N. Sane Trilogy*, Activision has remastered and repackaged three of the most classic titles in the franchise, with developer Vicarious Visions giving Naughty Dog's beloved trilogy an absolutely gorgeous modern day sheen. The visuals are improved even further by the PS4 Pro, which features enhanced textures and lighting, and bumps the resolution up to 1440p (unfortunately, the game stays locked to 30fps in either version). Crash's fur in particular looks incredibly detailed, reacting realistically to sunlight and wind.

Along with the updated graphics, *N. Sane Trilogy* also boasts remastered music, rebuilt 3D models and new animations.

That's all well and good, but how does the gameplay stack up after all these years? The answer to that question is... surprisingly well, actually. Those unfamiliar with Crash's unique brand of soul-crushing, precision-based platforming may be tempted to throw their controller at the tellie on more than one occasion (particularly on some of the first game's more punishing levels), though they'll probably find themselves determined to keep playing until they've achieved success.

Things ease up a little with *Crash Bandicoot 2: Cortex Strikes Back*, allowing players to do a little more exploring for hidden passages and gems. The second game also brings some added polish into the presentation, with a more fleshed-out story that features cutscenes and voice acting.

The package rounds itself out nicely with *Crash Bandicoot 3: Warped*, which is perhaps the most forgiving title in the trilogy, even if its vehicle levels will likely have you tearing your hair out in frustration.

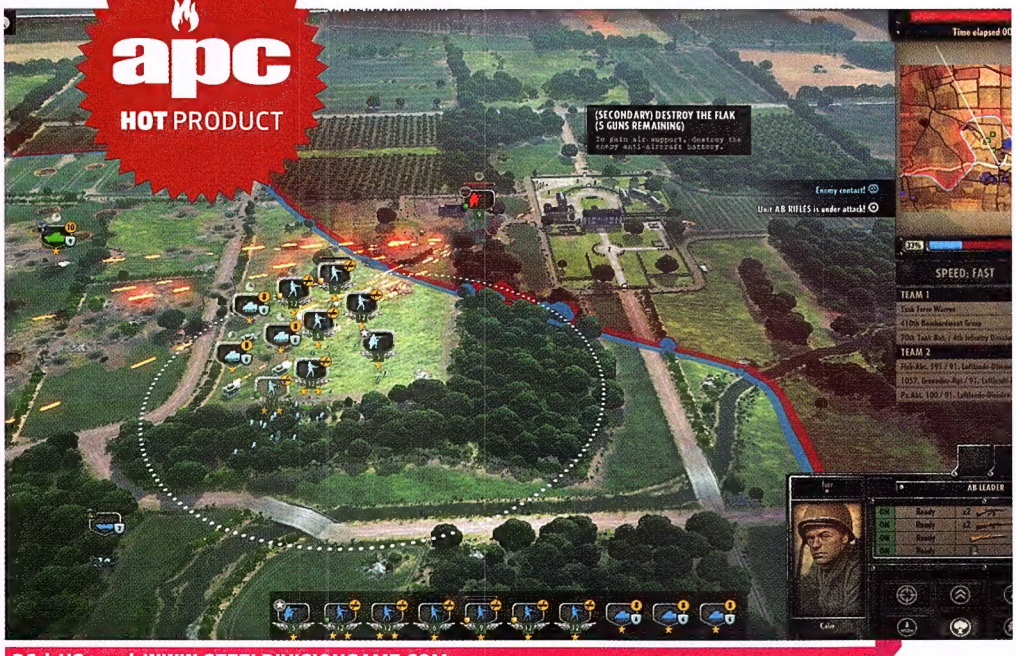
As a nice bonus, each of the games can be played almost entirely as Crash's younger sister, Coco — a character who originally became playable in the franchise's third instalment.

Fun and challenging in equal measure, *Crash Bandicoot N. Sane Trilogy* does a terrific job of bringing this once-mighty marsupial mascot to a new generation of players and to those nostalgic for the good old days of 3D platformers. It brings the old stories and levels back to life with new in-game save systems and leaderboards to keep you hooked.

Stephen Lambrechts

Verdict

Spin and wump your way to Nostalgia City with this trilogy of classic, challenging Crash games.



PC | US$40 | WWW.STEELDIVISIONGAME.COM

Steel Division: Normandy 44

The joys of stress and making units flee.

This game is a daunting fusion of the complexities of a WWII wargame and the micromanagement of a real-time strategy, set amid the ruined towns and hedgerow hell of Normandy. The *Wargame* series has always been demanding. Maps are interesting, units are authentically crafted with an almost fetishistic attention to detail and battles are as striking as they are challenging.

By zooming in on a specific part of the war, more attention has been given to the men and machines doing the fighting. Each unit is affected by stress. When a unit is hit or close to an explosion, it's pinned down and won't take orders. It can, however, be told to fall back. Vehicles, on the other hand, may start to move backwards when the pressure mounts, eventually retreating. Fights, then, become more about controlling territory and pushing foes back.

It doesn't matter what units you've fielded, they'll all freak out when the explosions start, and it can create dramatic fights.

The campaign is effective at teaching the basics, but otherwise it's disappointing. Its greatest crime is simply being dull. The *Wargame* series has always been a little sterile, but there's always some dynamism, like an evolving campaign map. Not here. It's just a linear series of 12 missions with simple objectives. Hold this town. Take this bridge. Fight wave after wave of enemies. It forces you to play in a certain way, while the more open nature of solo or multiplayer skirmishes are where the game becomes more liberating.

Six different countries are represented in skirmish mode by 18 divisions split equally between Axis and Allies. Each contains a different selection of units that inform how they're best employed. Rather than just selecting a division, you're creating your own custom battlegroup from a huge deck. Each match is split into three 10-minute phases, and some units are only deployable in phase B or C.

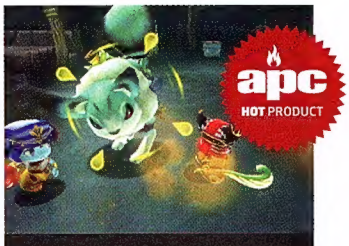
Knowledge of WW2 certainly comes in handy. Experience helps as well, so testing the waters in some easy co-op comp stomps is encouraged. Familiarity makes it easier to appreciate the myriad of subtle complexities – how most units carry more than one weapon, and each can be turned off in an effort to conserve ammo, or how a tank is made up of systems, armour, guns and even the men inside, and each can be damaged to reduce its effectiveness. With a team around you, it's possible to focus more on armour or artillery, letting you get to grips with specific units.

The moment-to-moment action is fraught with tension and is overflowing with meaningful tactical conundrums, but it really comes to life when you're plotting with others, carving up the map between you and figuring out ways to outsmart your opponents. It makes up for all the shouting you'll be doing at innocent, slow supply trucks. ■ Fraser Brown

Verdict

Disappointing campaign aside, *Steel Division: Normandy 44* is a compelling real-time wargame.

★★★★½



Ever Oasis

An action-RPG with true grit.

3DS | US$40
EVEROASIS.NINTENDO.COM

Ever Oasis mixes Link's obsession with hacking up monsters and trawling through dungeons with a light town-management sim. Grezzo's made sure the town-building aspect is as streamlined as possible, leaving plenty of time for venturing beyond the oasis gates. Think *Animal Crossing* rather than *Civilization*. The first hour gets bogged down in setting up the backstory and explaining mechanics, but it's not long before chores can be delegated to NPCs, freeing you to deck sand squirrels and save the world. Rather than follow in Link's solitary footsteps, *Ever Oasis* makes everyone a hero. The abilities of your fellow townspeople, not hookshots, will carry you through its vast network of caves and dungeons. It's a refreshing change from the squad of angsty teenagers who normally populate RPG rosters. Build more shops and attract more visitors, and you'll have a wider range of villagers to draw on. Puzzles frequently require a combination of abilities, resulting in some satisfying head-scratchers. Sometimes, you encounter a puzzle you can't solve with your current trio and have to warp back to town to swap party members. It's a reasonably painless process, but it stalls the game's momentum. Regardless, this is still a charming adventure that brings a new, fresh take on Zelda-style adventuring. ■ Katharine Byrne

★★★★½

Spoilerwall

A firewall that sends movie spoilers to hackers scanning your network ports.

Why settle for a normal firewall when you can have something that not only blocks intruders seeking to infiltrate your ports [*Uh... – Ed*], but that also takes a swipe at the person trying to break in? Spoilerwall aims to ruin your potential hacker's day by spitting out movie spoilers from SpoilMe in retaliation to their attacks. Just some of the little gems it might send to your hacker include: "The kids kinda did it", "He becomes a real boy", "The Aztec Prince isn't an Aztec and isn't a Prince" and "Old Stallone does brutal stuff. Man, you won't believe HOW brutal! Rambo kills an entire army without ever taking his shirt off", except with the movie title included as well. It's a little bit of fun payback, which you can look into further by visiting **github.com/infobyte/spoilerwall**.

When reading the Ts & Cs keeps you out of the sh*t

WI-FI! MY DIGNITY FOR SOME WI-FI!

When was the last time you read the terms and conditions for, well, anything? Most of us simply scroll down to the bottom and hit 'Yes', trusting that there's nothing unexpected lurking within the tiny lines of script. Well, public Wi-Fi company Purple added a spoof clause into their service agreement over a two-week stint, resulting in over 22,000 people signing up to help them out with various community service activities. While the company has said they're not actually going to ask people to pick up dog poop or clean portaloos, they did use this stunt to raise awareness to the fact that so many people "tick a box and consent to something unfair".

Amazon AI's smartphone case designs need some work

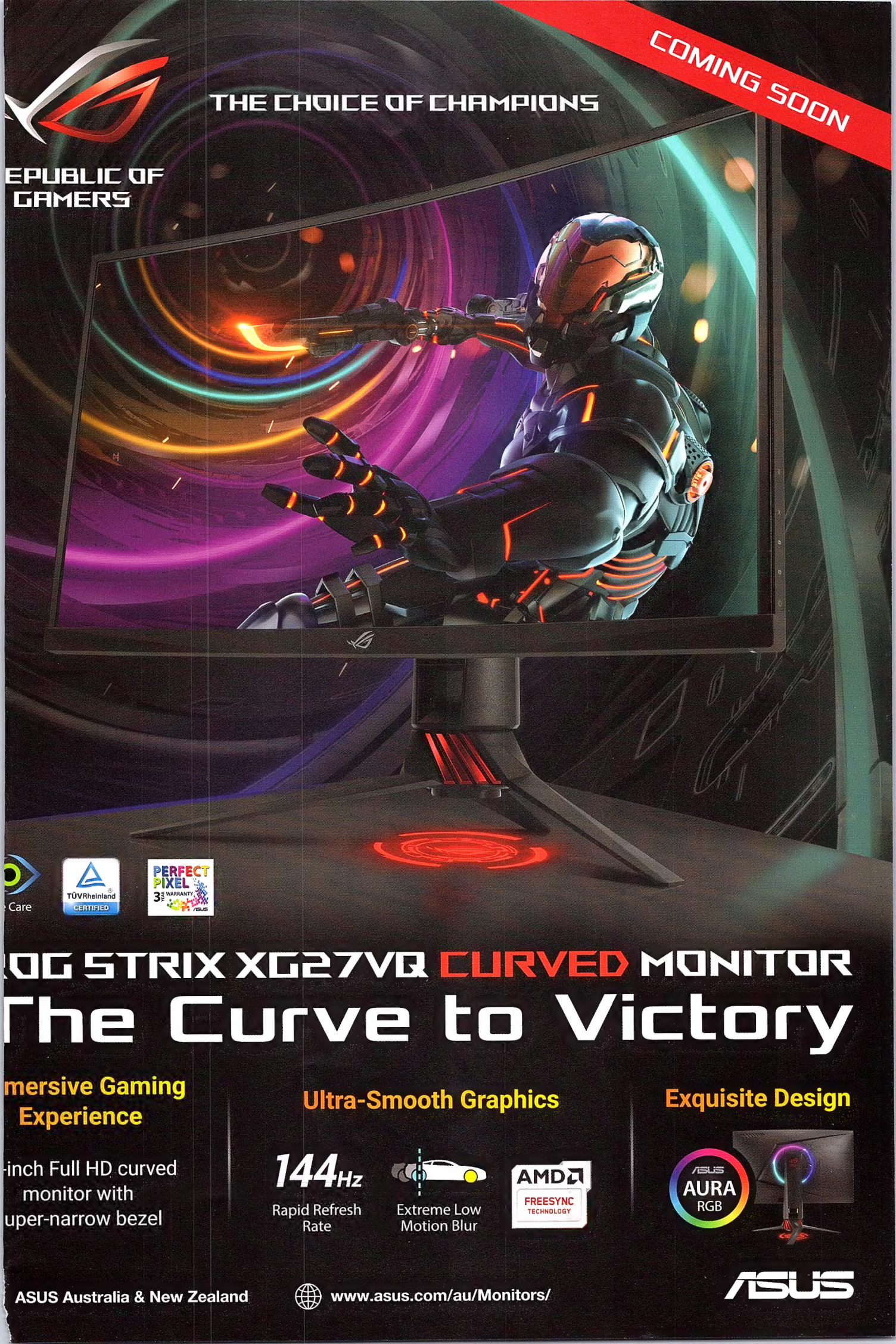
HANDY DESIGNS FOR DEIN HANDY?

Got a phone with a case on it? Is it a plain colour or does it have some kind of design? A friend of your humble writer loves her water-filled case with bright pink glitter. But perhaps you're the sort of person who'd like to have a personalised case with a picture of your cat or spouse. If that's the case, stay away from 'my-handy-design' on Amazon, because this bot has more than a few digital loose screws. Apart from a few not-too-bad stock photos of sunsets and woodland, it's also created cases featuring pictures of an ingrown toenail, a pile of contraceptive tablets, a woman having facial hair removal treatment, a pregnant woman lying on a bed with a pillow covering her face, and a picture of lots of different kinds of shaved meat. While a few users have left tongue-in-cheek comments on these items, we'd be surprised if anyone had actually bought one of them. This bot needs to go back to art school.

Smart speaker to the rescue

DIGITAL ASSISTANT CALLS POLICE TO BREAK UP DOMESTIC.

Early in July, police received a call from a home in Tijeras, New Mexico, and a violent altercation was heard down the line. Officers arrived at the premises to find a man wielding a firearm and threatening to kill his girlfriend. Apparently, the call to authorities had received had not been made by one of the residents, but by a smart speaker upon hearing the shouted phrase, "Did you call the sheriffs?" After a standoff, the man was taken into custody. The county sheriff commented that the smart device may have "helped save a life". While the police have issued no statement as to which kind of smart device was responsible, we understand that it was not a Google Home that made the emergency call, so hats off to all the other contenders. ■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